

*The Stirlingshire, West Lothian and Falkirk Growth Area Joint Planning Advisory Committee and Scottish Development Department*

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# The Grangemouth/Falkirk Regional Survey and Plan

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VOLUME 2

## Physical Planning Aspects



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EDINBURGH · HER MAJESTY'S STATIONERY OFFICE · 1968

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SCOTTISH DEVELOPMENT DEPARTMENT

Grangemouth/Falkirk Regional Survey and Plan  
Volume Two

CORRECTIONS

- Page 119 - bottom line After "Table 2" add "also Table 1 facing page 124."
- Page 120 - "Residential Areas" - last line for VI read VII.
- Page 132 - 2nd Para. last line for VI read VII.
- Page 153 - Map 64: Key, Item 5 for committee road committed.



EDINBURGH: HER MAJESTY'S STATIONERY OFFICE  
JULY, 1968

# The Grangemouth Falkirk Regional Survey and Plan

VOLUME 2

*prepared for*

STIRLINGSHIRE, WEST LOTHIAN  
and FALKIRK GROWTH AREA  
JOINT PLANNING  
ADVISORY COMMITTEE

consisting of

representatives from the County Councils  
of Stirling and West Lothian and the  
Town Councils of Falkirk, Grangemouth,  
Denny, and Bo'ness

*and*

SCOTTISH DEVELOPMENT  
DEPARTMENT

*in*

THE UNIVERSITY OF EDINBURGH

*by the Regional Consultants:*

PROFESSOR SIR ROBERT H. MATTHEW,  
C.B.E., M.A., A.R.S.A., P.P.R.I.B.A., M.T.P.I.,  
Professor of Architecture

AND

PROFESSOR PERCY JOHNSON-MARSHALL,  
M.A., DIP.ARCH. (LPOOL), A.R.I.B.A., A.M.T.P.I.,  
Professor of Urban Design and Regional Planning  
Director, Planning Research Unit

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## Preface and Acknowledgments

This Volume has been prepared in the Planning Research Unit of the University of Edinburgh. As recorded in Volume One, the Study was undertaken in response to a request made by the Stirlingshire, West Lothian and Falkirk Joint Planning Advisory Committee in association with the Secretary of State in July 1964. It followed the statement contained in Paragraph 26 of the White Paper, "Central Scotland: A Programme for Development and Growth" (Cmnd. 2188, November 1963).

We were invited to be Consultants with particular responsibility for the physical aspects of the Study, and the Planning Research Unit of the University of Edinburgh was invited to carry through this task. Throughout the preparation of Survey and Plan we have worked in close collaboration with the Consultant for the economic aspects, Professor D. J. Robertson, and his colleagues, of the University of Glasgow. In the Preface to Volume One, Professor Robertson has commented on the close and friendly relations existing between our two Universities in this work, and we would only say that this is fully reciprocated. Together with the officials in the local authorities concerned and the Scottish Development Department, the whole project has represented an important example of close teamwork throughout, and we wish to acknowledge the full co-operation we have received at all times.



# List of Contributors

**REGIONAL CONSULTANTS** PROFESSOR SIR ROBERT H. MATTHEW,  
C.B.E., M.A., A.R.S.A., F.P.R.I.B.A., M.T.P.L  
PROFESSOR PERCY JOHNSON-MARSHALL,  
M.A., DIP.ARCH. (L'POOL), A.R.I.B.A., A.M.T.P.L,  
Director, Planning Research Unit

## THE PLANNING RESEARCH UNIT

RICHARD T. BIGWOOD, Executive Director, Planning Research Unit  
A.A.DIP., S.P.DEP., A.R.I.B.A., A.R.I.A.S., A.M.T.P.L  
JERZY KOZLOWSKI, M.ARCH.(KRAKOW), M.A.P.A., M.S.P.T.P., DIP.LURB.(PARIS)  
JAMES HOPE, DIP.L.A.(EDIN.), S.D.H., A.I.L.A.  
SERGE DOMICELJ, B.ARCH.(BUENOS AIRES), DIP.LURB.(PARIS), DIP.G.D.(EDIN.),  
CERT.C.P.(THE HAGUE), M.A.A.A., A.M.T.P.L  
MISS SHIELA McDONALD, D.A.(EDIN.), DIP.T.P.(EDIN.), A.R.I.B.A., A.M.T.P.L  
MRS. GILLIAN PENROSE, DIP.ARCH.(R.W.A.), A.R.I.B.A., DIP.G.D.(EDIN.), A.M.T.P.L  
IVOR SAMUELS, A.A.DIP., A.R.I.B.A.  
Miss ANN CARRECK, B.A.HONS.(EXETER), DIP.L.A.(EDIN.)  
Miss ANNETTE ROBERTSON, M.A.(ST.A.)  
Mrs. MARGARET RODGER

### Part-time

GORDON S. ADAMS, J.P., B.ARCH.(N.S.W.), DIP.ARCH.(S.Y.C.), DIP.T.C.P.(SYD.), C.I.D.(LOND.),  
A.R.I.A.S., A.R.I.B.A., A.M.T.P.L, A.M.A.P.L (Jan. 65-Aug. 65)  
JOHN THOMSON, DIP.ARCH.(ABERDEEN), A.R.I.B.A., A.R.I.A.S., DIP.G.D.(EDIN.),  
A.M.T.P.L (Jan. 65-Aug. 65).  
HERMANN STUMME, DIP.ING.(DARMSTADT) (Jan. 65-Oct. 65)  
Miss SHEILA SUTTON, M.A.(EDIN.) (Jan. 65-June 65)  
Miss CLAIRE RIVAZ, M.A.(EDIN.) (Nov. 65-Aug. 66)  
WILLIAM MORRIS, B.Sc.ENG.(EDIN.) (July 66-Aug. 66)

---

Dr. J. B. SISSONS, M.A., Consultant on Geomorphology  
J. C. WYLIE, B.Sc., M.L.C.B., Consultant on Utility Services



# Contents

	page
Preface and Acknowledgments	v
List of Contributors	vii
<b>PREAMBLE</b>	<b>1</b>
<b>DEFINING THE TASK</b>	
1. Organisation and Terms of Reference	5
2. National and Regional Context	5
3. The Method of Approach	6
<b>PROCESS OF SOLUTION</b>	
<b>Phase One</b>	
DATA AND ANALYTICAL STUDIES: PHYSICAL CHARACTERISTICS	11
1. Natural Features	15
2. Land Uses and Environment	27
3. Infrastructure	69
4. Growth Potential (First Sieve)	80
RESEARCH STUDIES: POSSIBLE DEVELOPMENT PATTERNS	91
1. Model Research Process and Planning Principles	93
2. Hypothetical Development Models	93
3. Assessment: The Urban Region	98
FIRST SYNTHESIS	101
1. Background to Physical Development	103
2. Physical Structure: Model 7	105
3. Testing Model 7	108
<b>Phase Two</b>	
DATA AND ANALYTICAL STUDIES: PHYSICAL CHARACTERISTICS	109
1. Urban Growth Potential	111
2. Threshold Cost Assessment	121
3. Intensity of Urban Development	125
RESEARCH STUDIES: POSSIBLE DEVELOPMENT PATTERNS	127
1. Towards an Ideal Urban Environment	129
2. Towards an Acceptable Communication Network	133
3. Towards a Feasible Recreational System	142
FINAL SYNTHESIS	147
1. Formulation of Joint Policies	149
2. Development Patterns: Model 8	152
3. Testing Model 8	154
<b>Phase Three</b>	
RECOMMENDATIONS	157
1. Growth Area Structure Plan 1986	159
2. Land Uses and Environment	160
3. Infrastructure	179
4. Long-term Physical Growth (beyond 1986)	185
5. Conclusions	187

<b>INTERPRETATION OF RECOMMENDATIONS</b>	<b>page</b>
PROCESS OF IMPLEMENTATION . . . . .	189
1. Programming and Urbanisation Policies . . . . .	191
2. Process of Application . . . . .	196
PROVISION FOR CONTINUOUS REVIEW . . . . .	213
1. Opportunities and Approach . . . . .	215
2. Indications for Further Research . . . . .	216
<b>APPENDICES</b>	
1. Drift Geology in relation to Foundations . . . . .	219
2. Environmental Assessment of Urban Areas . . . . .	222
3. Education . . . . .	224
4. Study of Protective Zones for Noxious Industries . . . . .	226
5. Rehabilitation Areas . . . . .	229
6. Analysis of Random Sample of Municipal Compost after maturing in Windrows for Three Months . . . . .	232
7. Historic and Architectural Interests . . . . .	233
<b>BIBLIOGRAPHY</b> . . . . .	235

## List of Illustrations

### MAPS AND SKETCHES

1. National Context . . . . .	4	34. Industry—II. Accessibility affecting Location of Industry . . . . .	81
2. Regional Context: The Central Belt . . . . .	6	35. Industry—III. Urban Land Use affecting Location of Industry . . . . .	82
3. Location of Growth Area . . . . .	16	36. Industry—IV. Classification of Land for Location of Industry . . . . .	83
4. Relief . . . . .	16	37. Residential—I. Negative Factors . . . . .	84
5. Slope Analysis . . . . .	17	38. Residential—II. Positive Factors . . . . .	85
6. Orientation of Slopes . . . . .	17	39. Residential—III. Modifiable Limitations . . . . .	85
7. Morphological Types . . . . .	18	40. Residential—IV. Synthesis . . . . .	86
8. Natural Drainage . . . . .	18	41. Agriculture . . . . .	87
9. Solid Geology . . . . .	20	42. Forestry . . . . .	88
10. Drift Geology . . . . .	21	43. Recreation . . . . .	88
11. Soils . . . . .	22	44. Hypothetical Development Model 1 (Monocentric) . . . . .	95
12. Rainfall (inches per year) . . . . .	23	45. Hypothetical Development Model 2 (Linear) . . . . .	96
13. Stirlingshire 1654 . . . . .	28	46. Hypothetical Development Model 3 (Polynucleated) . . . . .	97
14a. Historic Growth up to 1760 . . . . .	29	47. Model 7 . . . . .	106
14b. Historic Growth up to 1860 . . . . .	29	48. Directions of Growth—Model 7 . . . . .	106
14c. Historic Growth up to 1900 . . . . .	30	49. Threshold Analysis—Natural Features . . . . .	112
14d. Historic Growth up to 1965 . . . . .	30	50. Threshold Analysis—Natural Drainage . . . . .	112
15. Soil Fertility . . . . .	40	51. Threshold Analysis—Sewerage . . . . .	114
16. Woodland . . . . .	40	52. Threshold Analysis—Existing Roads Network . . . . .	116
17. Assessment of Residential Environment —Grangemouth . . . . .	48	53. Threshold Analysis—Existing Urban Structure . . . . .	116
18. Mining (Past) and Outcrop . . . . .	55	54. Threshold Analysis—Partial Synthesis (1) . . . . .	118
19. Mining (Present and Future) . . . . .	55	55. Threshold Analysis—Partial Synthesis (2) . . . . .	118
20. Landscape Analysis . . . . .	59	56. Threshold Analysis—Final Synthesis . . . . .	119
21. Scientific Interests . . . . .	66	57. Threshold Analysis—Urban Growth Potential . . . . .	119
22. Existing Development 1965 facing page 68 . . . . .	68	58. Threshold Costs—Specification and Allocation . . . . .	124
23. Electricity Supply . . . . .	70	59. Spine and Rib Road System . . . . .	125
24. Water Supply . . . . .	71		
25. Gas Supply . . . . .	71		
26. Refuse Disposal . . . . .	73		
27. Drainage . . . . .	75		
28. Existing Roads System . . . . .	75		
29. Port . . . . .	77		
30. Proposed Dock Improvements . . . . .	77		
31. Railways . . . . .	78		
32. Rail-Passenger Flows . . . . .	78		
33. Industry—I. Natural Features affecting Location of Industry . . . . .	81		

60.	Radial Road System . . . . .	136	78.	Antonshill—Main Pedestrian Routes . . . . .	199
61.	Hexagonal Road System . . . . .	138	79.	Antonshill—Road System . . . . .	200
62.	Recreation . . . . .	145	80.	Antonshill—Evening Peak Traffic Flows (1983) . . . . .	201
63.	Model 7—Modifications . . . . .	153	81.	Antonshill—Environmental Area . . . . .	202
64.	Model 8 . . . . .	153	82.	Falkirk Town Centre (1) . . . . .	203
65.	Structure Plan—Analysis of Land Use . . . . .	161	83.	Falkirk Town Centre (2) . . . . .	204
66.	Basic Residential Units . . . . .	166	84.	Falkirk Town Centre (3) . . . . .	205
67.	Revitalisation of Existing Environment —Grangemouth . . . . .	169	85.	Falkirk Town Centre (4) . . . . .	206
68.	Shopping . . . . .	170	86a.	Falkirk Town Centre (Looking into the Grounds of the Parish Church from Kirk Wynd) . . . . .	208
69.	Industry—Classification of Land for Location of Industry after Implementation of Recommended Road System . . . . .	174	86b.	Falkirk Town Centre (The Grounds of the Parish Church) . . . . .	209
70.	Refuse Disposal Collection and Major Tipping Areas . . . . .	181	86c.	Falkirk Town Centre (The Grounds of the Parish Church from the street) . . . . .	209
71.	Regional Policy for Drainage—Co-ordination of Existing and Proposed Drainage Schemes . . . . .	186	86d.	Falkirk Town Centre (Approaching High Street from the East) . . . . .	210
72.	Recommended Road System . . . . .	186	86e.	Falkirk Town Centre (Looking out from the Grounds of the Parish Church to New Market Street) . . . . .	210
73.	Growth Possibilities after 1986 . . . . .	188	86f.	Falkirk Town Centre (The Steeple) . . . . .	211
74.	Structure Plan 1986 . . . . .	188	87.	Thickness of Soft Deposits above Boulder Clay, Gravel or Rock . . . . .	221
75.	Phasing of Development—Industry, Residential and Roads . . . . .	194	88.	Rehabilitation—Site Identification . . . . .	230
76.	Antonshill—Location in the Region . . . . .	197	89.	Protective Zones . . . . .	227
77.	Antonshill—Site Influences . . . . .	198	90.	Historic and Architectural Interests . . . . .	233

## DIAGRAMS

I.	Physical Planning Process (Figs. 1-3) . . . . .	9	VI.	Shopping Catchments . . . . .	130
II.	Geological Section (Along Line A-B) . . . . .	20	VII.	Residential Structures . . . . .	131
III.	Frequency, Speed and Direction of Wind . . . . .	24	VIII.	Traffic Desire Line 1 (Evening Peak Flows) . . . . .	141
IV.	Threshold Costs Curve . . . . .	121	IX.	Traffic Desire Line 2 (Evening Peak Flows) . . . . .	141
V.	Threshold Costs—Comparison . . . . .	123	X.	Falkirk Town Centre (5) . . . . .	207

## PHOTOGRAPHS

1.	River Carron near Carronshore . . . . .	19	15.	'A' class environment, Bo'ness . . . . .	49
2.	Central Area, Falkirk, looking west (copyright Aerofilms) . . . . .	16.	'B' class environment, Stenhousemuir . . . . .	49	
3.	High Street, Falkirk . . . . .	31	17.	Callendar Riggs shopping centre, Falkirk . . . . .	50
4.	Grangemouth, looking north (copyright The Scotsman) . . . . .	32	18.	Shops at Larbert . . . . .	50
5.	Pedestrian street to centre, Bo'ness . . . . .	33	19.	Charlotte Dundas shopping centre, Grangemouth . . . . .	51
6.	The Pineapple, Dunmore Park . . . . .	34	20.	Grangemouth Docks (copyright The Scotsman) . . . . .	54
7.	Westquarter . . . . .	35	21.	Grangemouth Stadium . . . . .	57
8.	Airth Village . . . . .	36	22.	Union Canal . . . . .	60
9.	Industrial air pollution . . . . .	37	23.	Playing field, north of Stirlingside . . . . .	60
10.	Miners' rows, Bo'ness . . . . .	43	24.	Dereliction at Bonnybridge . . . . .	62
11.	Traditional terraces, Falkirk . . . . .	44	25.	Near Mungo Farm, Falkirk (site of the proposed Central Park) . . . . .	63
12.	Inter-war housing, Stenhousemuir . . . . .	44	26.	Northern margin of the Slemishian Plateau . . . . .	63
13.	Charlotte Dundas development, Grangemouth . . . . .	45	27.	Bonnybridge Power Station . . . . .	70
14.	Polmontbank developments, Polmont . . . . .	45			

# Preamble

## INTRODUCTION

The Second Volume of the Report on the Grangemouth/Falkirk Development Study deals with the physical aspects of the Growth Area. The Terms of Reference to the Consultants states that a scheme of development in the form of an advisory plan was required, covering both physical and economic aspects, and reference was made to the White Paper entitled 'Central Scotland. A Programme for Development and Growth' (Cmnd. 2188). The latter states that "a study has therefore been undertaken to identify these areas within Scotland which seem to be most capable of substantial and rapid growth, taking all relevant factors into account". Three main categories were set out, one of which was described as "consisting of growing urban areas where further industrial and housing development is possible on a considerable scale", and the Grangemouth/Falkirk Area was cited as a specific example.

In inviting an economic team from the University of Glasgow and a physical planning team from the University of Edinburgh to undertake this work, the Secretary of State was following the precedent he had already established in inviting both teams to prepare a Regional Survey and Plan for the Growth Area of the Lothians. Thus, the collaboration already established successfully between the two Universities was of great assistance in the execution of the present Study, and the Edinburgh team would like to take the opportunity of saying how appreciative they have been of the excellent spirit of collaboration that has prevailed with their Glasgow colleagues throughout the Study.

## LOCATION

The Grangemouth/Falkirk Area, as determined by the Secretary of State for the purpose of the Study, is approximately one hundred square miles in extent. It is located along the south-eastern littoral of the Firth Estuary, and is almost equidistant from Edinburgh to the south-east and Glasgow to the south-west. Almost immediately to the south-east is the New Town of Cumbernauld, while a few miles to the south is the Growth Area of the Lothians, which was the subject of the earlier Study, The Lothians Survey and Plan.

## NATURE OF THE AREA

The general land form of the Area is complex, consisting of flat tidal mudflats along the Firth, rising up to the Lammermuir Plateau on the south, and the high moorland hills of the Campsie Fells on the west. Below the surface of the ground there are and have been extensive deposits of coal and fireclay, which were the main cause of the large initial

industrial growth in the nineteenth century, but which have declined in importance in the twentieth. The Area is of particular interest in that it contains not only these older industrial settlements centring on the town of Falkirk, but has also the new and rapidly growing sea port of Grangemouth, which has attracted a large new petro-chemical industrial complex on the flat land of the Firth Estuary. In addition, it lies near the centre of Scotland's Central Belt (with seventy-five per cent of the population), so that communications running between north-east and south-west and north-west and south-east pass through it. A number of the major developments in the vicinity of the Area include the new University of Stirling, located near the historic city of that name; the Kincardine Bridge, linking the southwest with the north-west; and two large thermal power stations, one adjacent to the Bridge at Kincardine, and the other now under construction at Longannet across the Firth Estuary.

## FACTS FROM THE SURVEY

The survey facts revealed a complex but challenging set of problems. Foremost was the poor quality of environmental standards in the older industrial settlements, caused for the most part by the smudge of industry and housing, arising from early industrial growth and the resulting blight. Consequently, a considerable number of man-made limiting factors had to be added to the limitations imposed by natural conditions, the latter including the many north-facing slopes and the exposed conditions of the upper plateau and hill areas.

Although the Area has suffered from the environmental effects of industry in the past, nevertheless partly because of their existence it offers good growth potential for the future. The utility services, too, are all available and capable of serving an expanded population without exorbitant expenditure. In so far as the communications network is concerned, the Area is well served with rail services for both passenger and goods traffic, and the main Edinburgh/Glasgow line passes through it. As regards roads, the network is inadequate, muddled, and wasteful, and requires extensive redevelopment. Seaport facilities are good, although there is an access problem which limits the tonnage of ships using the Grangemouth docks.

## CAPABILITY

From all the facts assembled, it was considered that the Area was capable of growth from the existing population of 124,000 to one of 230,000, and that there would be adequate space for subsequent natural increase. In determining the final planning proposals, six alternative models of

development were first considered. Three of these were selected for further studies and checked against a large number of critical factors. From these emerged Model No. 7. The latter was used as a test study and checked in collaboration with the Working Parties, after which the preferred solution was developed.

## PROPOSALS

From all these studies recorded in this Volume, which included the application of the new Threshold Analysis techniques, the final planning proposals emerged.

Broadly, it is recommended that Falkirk should be developed as the main centre of a considerably enlarged urban complex or regional city. Two major industrial areas are proposed: a large one near the docks at Grangemouth, mainly for large installations, and the other further west, adjacent to Bonnybridge, suitable for smaller industries. Other smaller industrial estates are located throughout the Area.

The new predominantly residential areas proposed are situated south of Falkirk, and in a series of clusters along the north of the Area, from Denny in the west across to Carronshore in the east. For both existing and proposed new residential areas general and particular recommendations are made, which cover a wide range of environmental factors. No totally new towns are proposed, and it is assumed that the new residential areas will take the form of expansion of the existing conurbations, but with greatly improved community facilities. Shopping catchments in particular have received careful attention and, in addition to the major centre of Falkirk, eight district shopping centres will be required, of which three will be completely new.

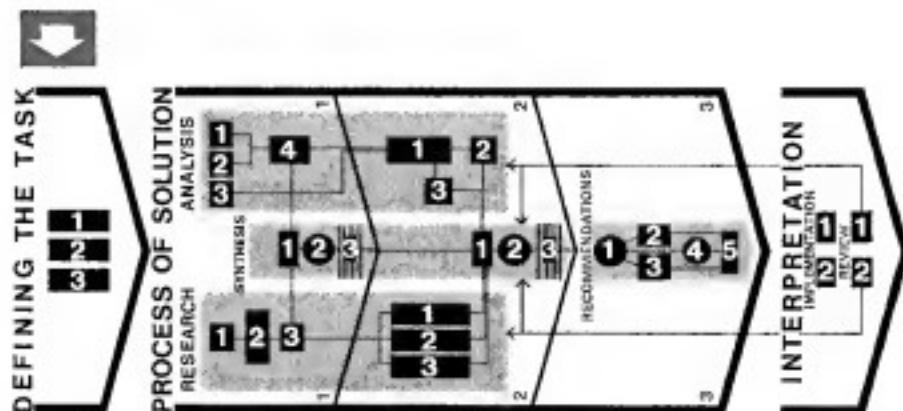
Recreational needs have likewise received special consideration not only in terms of urban parks, green links, and walkways, all interrelated into a total open space system, but also in relation to the complex but often insufficiently organised pattern of non-urban land uses, which have received a great deal of study and have resulted in a set of proposals to convert the hitherto neglected Slansman Plateau into a productive area for agriculture, forestry and recreation.

Finally, and totally integrated into the existing and proposed pattern of land uses, is the proposed infrastructure of roads and services. In particular, the road system is based on the need to reduce the journey to work to a minimum, and to develop a clear functional hierarchy in terms of national routes, primary distributors, district distributors, and service roads. An attempt has been made to combine a high standard of accessibility with an equally high standard of environmental safety and quality.

What emerges from the total study of a complex and at present environmentally unsatisfactory area, is a surprising range of possibilities for development with high environmental standards. Provided it is treated in a comprehensive way, and piecemeal developments are avoided, the Area offers excellent prospects of making a new contribution to Scotland's strictly limited living space.

If it is to succeed, the kind of environmental strategy outlined in this Report has to be followed up by a high standard of design in every aspect of development whether it is a town centre, a residential area, a new road, or an industrial complex. Here, however, is presented the result of a comprehensive and detailed study for an area which could make a major contribution to human environment.

# Defining the Task



## 1. ORGANISATION AND TERMS OF REFERENCE

Consultants—Terms of Reference—Comments

## 2. NATIONAL AND REGIONAL CONTEXT

Historical context—Economic Policy—Needs for Study—Definition of Study Areas—Grangemouth/Falkirk as a "sub-regional" Plan

## 3. THE METHOD OF APPROACH

Theoretical Basis—Model Method—Main Stages of the Planning Process—Practical Application

This Section is designed to supply as briefly as possible the background to the preparation of the Grangemouth/Falkirk Growth Area Plan. At the outset of any task it is essential to state the problem and list the resources which can be deployed in its solution, find out why the problem has arisen and requires to be solved, and decide how best it can be tackled within the limits of resources available. The three parts of this Chapter attempt to cover these points under the headings "Organisation and Terms of Reference", "National and Regional Context", and "The Method of Approach".

It is important to distinguish here between the immediate task, the preparation of an Advisory Plan, which can be carried out in a limited period of

time, and the much larger task of stimulating and guiding growth along lines suggested in the Advisory Plan, a task which may take very many years to accomplish. In this study the Consultants have devoted a great deal of attention to the examination of the process of preparation of an Advisory Plan, rather than to the examination of the process of implementation of the Plan. This is in large part due to a need to begin to redress the comparative weakness of British planning on the theoretical side. It should be further said that, despite the greater strength of British planning in practice, it is felt that aspects of implementation should be the subject of further intensive studies at some future date.



Map No. T: National Context

### 1. Organisation and Terms of Reference

In the autumn of 1964 the Stirlingshire, West Lothian and Falkirk Growth Area Joint Planning Advisory Committee was set up, and, with the Secretary of State for Scotland, commissioned Consultants Professor D. J. Robertson, of the Department of Social and Economic Research in the University of Glasgow, and Professors Sir Robert H. Matthew and P. E. A. Johnson-Marshall<sup>[1]</sup> of the Department of Architecture in the University of Edinburgh, to prepare a Growth Area Plan for Grangemouth/Falkirk in the following terms:

- 1 to carry out a survey and prepare a scheme of development for the Area defined in the White Paper "Central Scotland: a Programme for Development and Growth" (Cmnd. 2188) as the Grangemouth/Falkirk Growth Area and adjoining districts; and for this purpose to consider and report on the economic, social and physical planning problems presently existing and likely to arise in the course of development of the Area along the lines indicated in the White Paper.
- 2 to present the scheme of development in the form of an Advisory Plan, covering both the physical planning aspects in terms of the Town and Country Planning (Scotland) Act, 1947 to 1959, and the economic aspects, including proposals for capital investment and measures to stimulate economic growth.

3 to present a report on the survey and the scheme of development (both of which will be published) to the Joint Planning Advisory Committee in 1966.

The Consultants were at the same time engaged on the closing stages of work on the Lothians Regional Survey and Plan. It was known that a number of members of staff of the Department of Social and Economic Research in Glasgow University, and of the Planning Research Unit in Edinburgh University who had been engaged on that project would be able to continue to collaborate on the new project, bringing a wide range of disciplines to bear on the problem. Thus an invaluable opportunity arose to build on the knowledge and experience gained in the earlier exercise, and this opportunity the Consultants readily took, the two teams continuing to work in their own Universities.

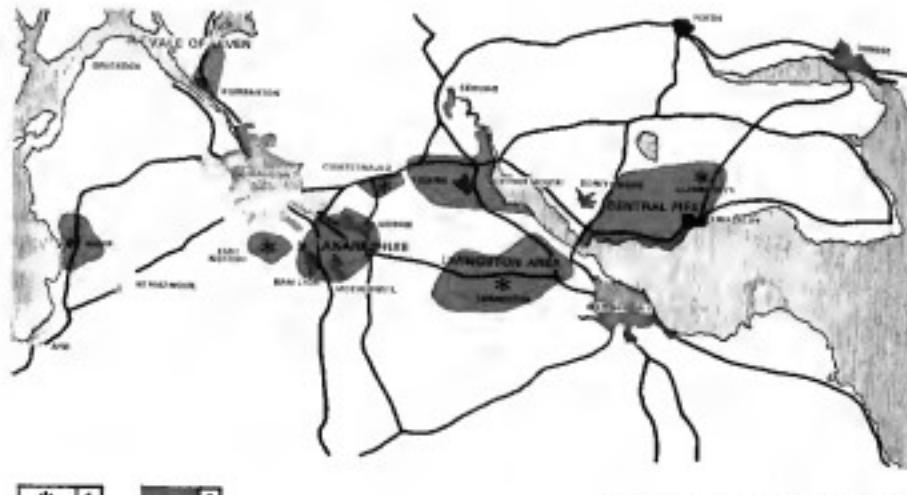
In the course of the Study, the Consultants have had the unstinting co-operation of the representatives of the Local Authorities and the Scottish Development Department at an informal level, and at the Technical Committee, and the Technical Working Parties on Services and Transport which were set up as the work progressed.

<sup>[1]</sup> Professor Johnson-Marshall is now head of the Department of Urban Design and Regional Planning, which was established in January 1967.

### 2. National and Regional Context

The Area covered by the terms of reference extends to approximately eighty two square miles in east central Scotland. Its location is shown on Map Nos. 1 and 2 "National Context" and "Regional Context". Bounded on the north-east by the River Forth, it extends from Bo'ness in the east to the boundary of Cumbernauld New Town in the west, and the whole area lies north of an imaginary line drawn from Edinburgh in the east to Glasgow in the west. The reasoning behind the selection of the Area for intensive study can be explained in an historical context. Since 1945 planning in Britain has undergone a number of changes, and some landmarks in the process leading to the present emphasis on studies of a sub-regional nature may usefully be recalled. At first the drift of population to the south-east of England was tackled by an attempt to disperse population to New Towns within the urban region; serious inequalities (such as an unemployment rate in Scotland of twice the national average) were tackled by the "development

district policy" of financial inducements; later, in 1961, the Toothill Report on the Scottish Economy formulated the "Growth Area" concept and this led in turn to the commissioning of the Lothians Regional Survey and Plan, a joint study by economists and physical planners of an area of potential growth round a New Town, which was linked to Glasgow's overspill programme. Economic policy based on Growth Areas was more precisely formulated in the White Papers on the North-East and on Central Scotland. This latter (Cmnd. 2188: 1963) envisaged heavy spending on infrastructure in an area containing seventy-five per cent of Scotland's population and ninety per cent of Scotland's manufacturing industry, but still suffering from the decline of those industries based on coal and iron which were the foundation of its intensive urbanisation. In this White Paper, the Growth Area of Grangemouth/Falkirk was expressly cited as presenting physical planning features of a complex character affected by the proposed Edinburgh/Stirling Motorway and the



Key: 1. New Towns. 2. Growth Areas.

Map No. 2: *Regional Context: The Central Belt*

British Transport Deck Board's proposals for the port of Grangemouth. The relation of this Edinburgh/Stirling route to the National Motorway System is shown on Map No. 2 "Regional Context", and the relation of the Area to the Lothians Area, Livingston New Town, and Cumbernauld New Town, in the rapidly growing Central Belt of Scotland can also be seen. Within the Area itself, administrative boundaries cut through existing development, making a study of this Area as a whole essential. Since work began on the Study, the Government has shown its determination to extend the work of regional study by setting up Regional Boards and Councils under the Department of Economic Affairs to service the work of national planning outlined in the 1965 National Plan and the Plan for the Scottish Economy, 1965-1970 (Cmnd. 2884). The Area forms a part of the wider region of Central Scotland which includes North Lanarkshire and Central Fife, and is therefore considered to be sub-regional in scale.

Although the concept of "sub-region" has not yet been fully recognised in planning practice and terminology, many arguments support its introduction.<sup>[1]</sup>

The Grangemouth/Falkirk Growth Area corresponds closely to the idea of "sub-region", in that it is a mainly homogeneous area within which there is

intense daily movement of people between their homes and places of work. Sub-regional studies form a major physical planning contribution to the work now being undertaken by Consultants throughout the country, and can be readily defined. A sub-regional plan is mainly devised for areas which are homogeneous as regards their natural environmental features, and which at the same time are delimited by the outer limits of commuting journeys. The subject of the study is usually a group of human communities which are, or should become, a unified settlement system on a small scale. Its function is to act as an effective medium for communication between the levels of Urban and Regional Planning; as a guide to planning in areas under development where there is no comprehensive Regional Plan; and as an agent for the formulation of principles and the general framework of development as a whole. This type of plan aims at steering and controlling urbanisation policies in order to provide the best environment based on a functionally interdependent settlement structure. Although human values are given priority, the background of the planning proposals must be economically sound and directly relevant to the implications evolved from the existing conditions of the surveyed area. These demands can only be met when planning is the work of an inter-disciplinary team, as in the present exercise.

### 3. The Method of Approach

#### Theoretical Basis

##### *Model Method and its Function*

It need not be argued that logic and consistency in the planning process are vital to the construction of optimum regional, or sub-regional plans. The Consultants, therefore, gave particular thought to the most effective way of carrying out the complex task implied by the Terms of Reference within the confines of a two year study. To this end they attempted to build a Model Method for this type of plan and to test it by practical application to the Growth Area. The function of the Model Method is to provide a theoretical framework which defines the process of action as simply as possible and eliminates internal contradictions. The Report follows this

Model Method and thereby shows the interaction between the disciplines and the gradual evolution of the Plan much more clearly than did the Report on the Lothians Study.

##### *Main Stages of the Planning Process*

To construct the Model Method, the theoretical basis of the whole planning process has been analysed and its main stages defined as follows:

STAGE I: Defining the Task

STAGE II: Process of Solution

STAGE III: Interpretation of Recommendations

[1] see Donald Harris, "Regional Planning in its Context" (OAP, January 1966).

The subject of STAGE I, the Formulation of the Task, is clear and need not be discussed further. STAGE II presents the most dynamic part of the whole planning process and demands continuous creative thinking. Since it is complex, a further breakdown is made to simplify the framework of the Model Method. STAGE III covers first the definition of a programme of action and makes recommendations for the co-ordination of the legislative, fiscal and administrative measures, with a view to achieving the situation represented by the model of settlement structure which is the final product of the planning work in the STAGE II.

It is possible to define the main directions and the classification of the various types of studies within this part of the planning process. The Process of Solution is divided into three main analytical streams which are related continuously during the period of work, and integrated successively into the resultant final stream of synthesis.

The three analytical streams are as follows:

*Data and Analytical Studies:* Based on visits to the site, map investigation, and special technical and other studies, this serves to define the character and implications of the existing conditions, both for urban policies and for further physical growth. The degree of accuracy depends on the scale of the particular plan. Over-detailed analysis at this stage would be detrimental in the long run, where the main object is to formulate principles to guide overall development, and at the same time to serve as a basis for the more detailed evolution of planning at a local level.

*Research Studies:* This is based on comprehensive analysis of different selected theoretical patterns for both urban settlement structures and their various networks, to establish the range of development hypotheses, and to further the physical structure of the Plan.

*Socio-economic Studies:* An analysis of socio-economic and administrative aspects of existing conditions enables the formulation of demographic projections, estimation of potential labour force, and the calculation of the needs of the social services. This combined information helps to establish the overall development programme.

*Process of Synthesis:* The results from the three groups of studies are united into a final synthesis by broadly comparing the various possibilities deduced from the analyses of all the problems involved.

role of "client" and "consulting body". They influence the planning process throughout, particularly in the main social, economic and administrative aspects, and by evaluating the intermediate and final results of the synthesis.

#### *Model Method*

Figure 2, called the Model Method, shows the more detailed application of this "ideal" theoretical framework to the planning process, indicating its key elements. It may be useful to stress that STAGE III, Interpretation of Results, indicates two major directives of the Plan. The first defines the method to be applied to create the optimum possibilities for the implementation of the planning proposals and the phasing which the programme should follow; the second describes broadly the method and provisions for continuous review.

#### *Applied Method*

The practical application of the Model Method (Applied Method) elaborated in the Grangemouth/Falkirk Growth Area Plan (shown by Figure 3), is similar to its theoretical predecessors, so that only short explanations are necessary. These mainly concern the changes made in STAGE II of the Planning Process. This Stage was sub-divided into three phases, a process influenced by the organisation of the work and by the relationship between the Planning Research Unit and Local and Central Government Authorities.

To assist the Planning Authorities to meet current demands for development in the Area at the same time as the more refined stages of the advisory planning work were being elaborated, it was considered necessary to produce the first draft synthesis, and, consequently, a decision on the main directions of growth was formulated in the early stages of the planning work. A choice between the various development hypotheses had to be made much sooner than in the Model Method and was only based on the first part of the Growth Potential Studies (see Chapter on Growth Potential—First Sieve). Fortunately, the main characteristics of the Area and its limited possibilities for development were evident from the beginning, so it was possible to follow those administrative requirements, and to rearrange slightly the theoretical framework of the Model Method. In consequence, the Growth Potential Studies had to be divided into two parts, and since more detailed technical information (in particular on public utility networks) was not immediately available, the first analyses were based mainly on the natural characteristics of the Area, and thus defined the suitability of undeveloped land for main functions. Later this was used as a background for more sophisticated investigations into the possibilities for urban development, which included physical and economic aspects of the Threshold Analysis. (See Chapter on Urban Growth Potential and Threshold Costs Assessment.)

To enable the reader to understand Figure 3 readily, a list of contents is attached to Diagram 1 which by means of code numbers presents in detail all the main characteristics of the Planning Process applied to the Plan, in sequential order.

## Practical Application

### *General Model of Operation*

To assist the understanding of the inter-relationship and structure of the theoretical concepts described above, a number of diagrams are presented. (See Diagram 1 "Physical Planning Process".) Figure 1, called the Ideogram, shows the main stages of the Planning Process, indicating the dynamic character of STAGE II, which is divided into the four main streams described above. The Authorities are also represented in their two-fold

## **PHYSICAL PLANNING PROCESS (to be read in conjunction with Diagram 1)**

### **DEFINING THE TASK**

1. Organisation and Terms of Reference
2. National and Regional Context
3. The Method of Approach

### **PROCESS OF SOLUTION**

#### **Phase One**

##### **DATA AND ANALYTICAL STUDIES: PHYSICAL CHARACTERISTICS**

1. Natural Features
2. Land Uses and Environment
3. Infrastructure
4. Growth Potential (First Sieve)

##### **RESEARCH STUDIES: POSSIBLE DEVELOPMENT PATTERNS**

1. Model Research Process and Planning Principles
2. Hypothetical Development Models
3. Assessment: The Urban Region

##### **FIRST SYNTHESIS**

1. Background to Physical Development
2. Physical Structure: Model 7
3. Testing Model 7

#### **Phase Two**

##### **DATA AND ANALYTICAL STUDIES: PHYSICAL CHARACTERISTICS**

1. Urban Growth Potential
2. Threshold Cost Assessment
3. Intensity of Urban Development

##### **RESEARCH STUDIES: POSSIBLE DEVELOPMENT PATTERNS**

1. Towards an Ideal Urban Environment
2. Towards an Acceptable Communications Network
3. Towards a Feasible Recreational System

##### **FINAL SYNTHESIS**

1. Formulation of Joint Policies
2. Development Patterns: Model 8
3. Testing Model 8

#### **Phase Three**

##### **RECOMMENDATIONS**

1. Growth Area Structure Plan 1986
2. Land Uses and Environment
3. Infrastructure
4. Long-term Physical Growth (beyond 1986)
5. Conclusions

### **INTERPRETATION OF RECOMMENDATIONS**

##### **PROCESS OF IMPLEMENTATION**

1. Programming and Urbanisation Policies
2. Process of Application

##### **PROVISION FOR CONTINUOUS REVIEW**

1. Opportunities and Approach
2. Indications for Further Research

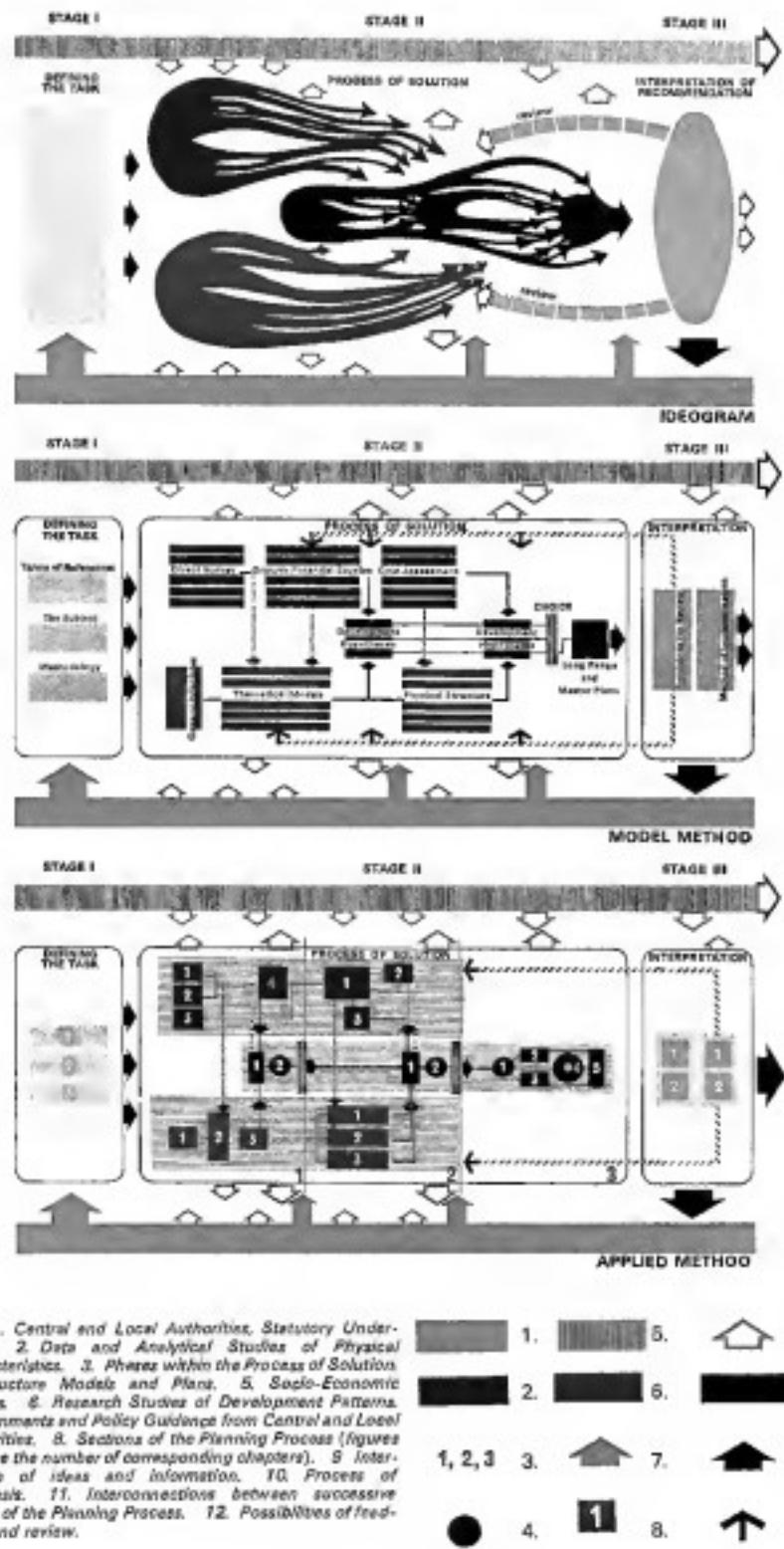
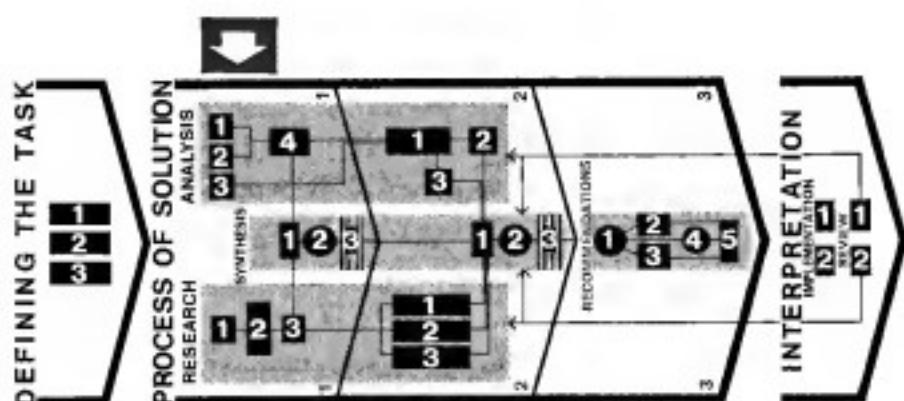


Diagram 1. Physical Planning Process.



# Process of Solution — Phase One



## Data and Analytical Studies: Physical Characteristics

### 1. NATURAL FEATURES

**RELIEF:** Distribution—dimension—degree—direction—morphological structure

**NATURAL DRAINAGE:** Basins and channels—areas of poor drainage—areas liable to flood

**GEOLGY:** Solid (introduction, oil shales, limestone, coal, millstone grit, productive coal, intrusive and extrusive basalt)—drift (introduction, boulders, sand and gravel, silt, clay and sand, coarse clays and silt, peat)—soils (introduction, clayey soils, sandy loam, silty clays, peat)

**CLIMATE:** Temperature—rainfall—snow—fog—wind—gales—sunshine

**PLANNING IMPLICATIONS:** Relief—natural drainage—geology (solid, drift, soils)—climate

This Section deals with those basic elements of the physical environment over which man has least control: the slope and form of the landscape and the resulting pattern of surface water drainage; the composition and disposition of the underlying rocks

and their various overburdens of debris and soil; and climate, the vagaries of which are the result of our day to day weather. A very close relationship exists between these factors, each affecting the others in a complex interplay of action and reaction.

### 2. LAND USES AND ENVIRONMENT

**SETTLEMENTS:** Settlements in the sub-regional context—character—outlying development

**SPECIAL ASPECTS OF THE ENVIRONMENT:** Air pollution—micro climate—safety—noise

**AGRICULTURE:** Hill farms—mixed farms—arable farms

**FORESTRY:** Types of woodland—distribution

**RESIDENTIAL:** Location and character of residential areas—residential densities—assessment of the residential environment

**SOCIAL FACILITIES:** Shopping—health—education

**INDUSTRY:** Location and character—employment densities—environmental factors

**MINING AND SUBSIDENCE:** Coal—fireclay—subsidence

## RECREATIONAL OPEN SPACE: Distribution

LANDSCAPE: Landscape types—rehabilitation

HISTORIC INTERESTS: Roman Wall—remains of wall—celebrated people connected with the area—historic remains

SCIENTIFIC INTERESTS: Suggested areas for conservation—faunal interests

PLANNING IMPLICATIONS: Settlements—social aspects of the environment—agriculture—forestry—residential—social facilities—industry—mining and subsidence—recreational open space—landscape—historic interests—scientific interests

In studying the land uses and environment of the Growth Area, the Regional Consultants have benefited by the invaluable collaboration of the Local Authorities and the Scottish Development Department. Some information had to be brought up to date and new data incorporated. Further data has been documented by the Department of Social and Economic Research, Glasgow University, in Volume One of this Report, which deals also with the settlement pattern, its growth, distribution, character and function (Vol. One, Chapter 2). In conjunction with their studies on individual land

uses, the Planning Research Unit has carried out a series of complementary studies taking particular account of those aspects which fundamentally affect the environment: air pollution, noise, micro-climate, road safety, and these are also dealt with in this section.

It is appropriate at this stage to relate briefly some of the basic information given in Volume One, Chapter 3, on the population supported by existing land uses.

The total population in the area in 1961 was 124,000. This was distributed in the following way:

Locality	Population	% increase or decrease over 1951 figure
Falkirk	58,044	+ 1.6
Graegemouth	18,857	+ 22.2
Denny and Dunipace	7,760	+ 14.0
Bo'ness	10,195	+ 2.5
Eastern District 1	19,834	+ 3.2
Eastern District 2	13,454	+ 4.0
Central District 2 (part)	12,031	+ 3.2
Bo'ness District	4,012	+ 6.8
Total	124,167	+ 5.6

Note: Of the total, some 4,150 persons lived in temporary and other non-permanent habitations.

The age and sex structure of the population in private households in 1961 can be summarised as follows; it included slightly smaller proportions of people in the youngest and oldest age groups than

the population of Scotland as a whole.

The overall acreage in the built-up areas is around 8,500 acres, making the overall gross urban density roughly 15 p.p.a.

Age Group	Male	Female	Total	% of total G/P
Under 5	5,566	5,192	10,758	9.0
5 - 14	10,680	9,926	20,406	17.0
15 - 34	15,939	16,285	32,224	26.8
35 - 64	22,552	23,461	46,013	38.3
65 and over	4,904	6,112	10,516	8.9
	59,041	60,976	120,017	100.0

## 3. INFRASTRUCTURE

PUBLIC UTILITY SERVICES: Electricity supply—water supply—gas supply—refuse disposal—drainage

COMMUNICATIONS: Road network—port and canal system—air—air transport

PLANNING IMPLICATIONS: Public utility services communications

This Section deals with the present investment in plant and networks which service the Area, and the implications it has for future development.

## 4. GROWTH POTENTIAL: FIRST SIEVE

Analysis—Synthesis—Conclusions for

INDUSTRY—RESIDENTIAL—AGRICULTURE—FORESTRY—RECREATION

The Physical and Analytical Studies were undertaken mainly to define the Area's growth potential (see also Phase 2, Data and Analytical Studies: Physical Characteristics). The first stage of this

Growth Potential Study, described in this Section, deals with the requirements of the major land uses, and is based mainly on natural factors.

Comprehensive analyses were undertaken to

reveal the "natural" possibilities for the further development of each main land use (industry; residential and ancillary uses; recreation; agriculture; and forestry), and thus to help to select the best directions of growth for the Area as a whole. The areas which were considered lie mainly outside Burgh boundaries or built-up land, although vacant dockets of land within these boundaries and not yet zoned in Development Plans were also included.

These Growth Potential Studies were also undertaken in order that a reasonable choice could be made from several Hypothetical Models which had previously been produced from theoretical studies; and to make possible an approximate assessment of the total population which the Area could ultimately accommodate.

By thoroughly examining the Area's natural features, the suitability of undeveloped land for each land use was determined by taking into account the positive, negative and modifiable factors affecting each of them.

*Negative Factors* are those which seriously restrict,

or entirely prevent development, or which make it very undesirable.

*Modifiable limitations* are those factors or policies which make land less suitable, or less desirable for development, so that improvements entailing capital expenditure, or negotiations will be necessary before development is possible.

*Positive factors* are those which are conducive to development, or which make it highly desirable.

Both the negative and positive factors for each of the five separate land uses were plotted on base maps, the unmarked areas being those with modifiable limitations. The resulting maps were then systematically compared, and the areas of conflict and compatibility between the land uses were noted. An allocation of priorities and further assessments of land suitability led to a series of possible solutions, culminating in what was called "Model T".

The remainder of this Section is devoted to a detailed description of the results obtained from the studies carried out for each land use.



# Data and Analytical Studies: Physical Characteristics

## 1. Natural Features

### RELIEF

The Growth Area is in the eastern part of Scotland's Midland Valley, which lies between the Firths of Forth and Clyde, the Grampian Highlands, and the Southern Uplands. It forms part of the Forth drainage system (see Map 3 "Location of Growth Area"), lying at the head of the Firth on its southern shore, and enclosed within the Ochil Hills, the Campsie Fells and the Stannan Plateau. The Growth Area boundaries do not always correspond to clearly defined physical features, sometimes following minor water channels and watersheds. Thus the Area's physical identity extends beyond its defined limits.

The relief of an area may be analysed and expressed in terms of the characteristics of its slopes, which are distribution, dimension, degree and direction. It is possible to distinguish seven major slope types (see Maps 5 and 6 "Slope Analysis" and "Orientation"). They are steep, moderate and flat; north, south, east and west facing.

### Distribution

The most obvious of the Growth Area's characteristics is the contrast between the areas of relatively flat land near sea level, and the surrounding hills (see Map 4 "Relief"). These hills rising from the plain in varying degrees of steepness and height are cut by major valleys, radiating east to Linlithgow and Edinburgh, south to Bathgate, west to Cumbernauld and Glasgow, and north to Stirling.

### Dimension

By classifying into large, medium and small, the number of possible slope types is increased to twenty-seven. Areas of less than one acre in extent were not recorded.

### Degree

Three grades of slope were selected to analyse this factor, and to indicate suitability for development (see Map 5 "Slope Analysis").

Flat: areas with a gradient of 1:20 or less;

Moderate: areas with a gradient of between 1:20 and 1:6;

Steep: areas with a gradient of 1:6 or more.

Most of the "flat" land is near sea level, in an extensive area covering more than a quarter of the Area's eighty-two square miles, known as the "Carse". The moderate slopes are evenly mixed with the remainder of the flat areas, forming an intermittent band between one to three miles wide, round the south, west, and north boundaries. Steep slopes, either linear or areas in form, are found erratically

throughout the Growth Area but with a concentration in the west and east, and immediately south of Larbert. The most extensive areas surround the summit of Darroch Hill, while others, mainly linear in form, are found up the Carron Valley, along the edge of the raised beach, and in the Avon Valley.

### Direction

Since the effect of orientation on slopes of less than 1:20 is negligible, only steeper slopes were recorded, as north, east, south or west facing. (See Map 6 "Orientation of Slopes").

The high proportion of north facing, and the relatively few east and west facing slopes is a feature of the Growth Area particularly along the fringe of the Stannan Plateau. Extensive slopes having a southern aspect are limited to Ainsgath Hill, Darroch Hill and the Torwood area; while up the Carron Valley and the Glen Burn Valley a few smaller areas occur.

### Morphological Structure

The morphology of any area depends on the number and variety of slope types per unit area; their shapes and profiles and their pattern of distribution (see Map 7 "Morphological Types").

In the Growth Area the various combinations of dimension and degree have produced five general types of morphological landscape:

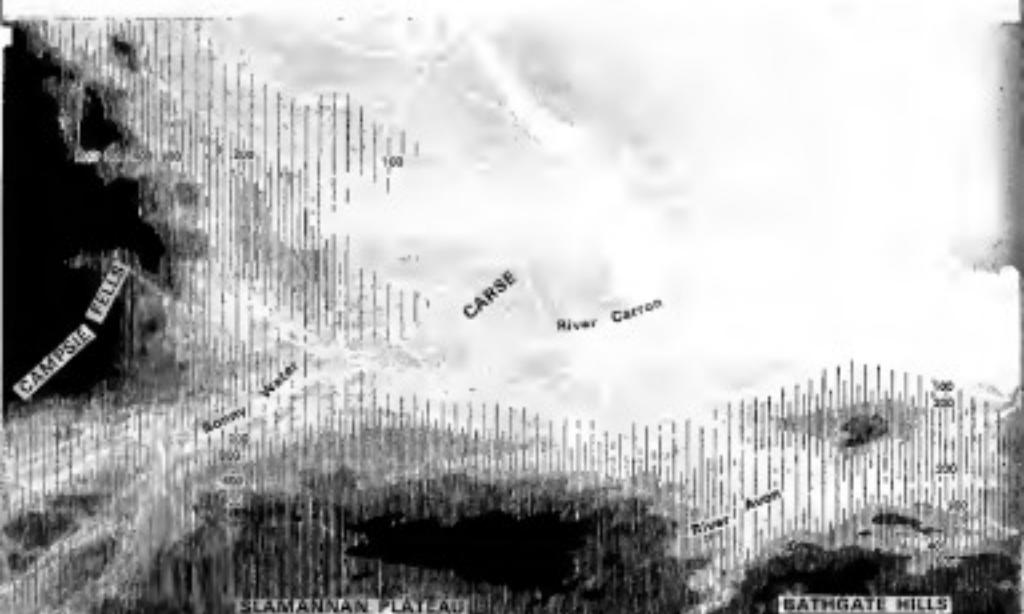
- 1 Areas composed mainly of large, flat slopes; they include the "Carse" and the Carron Valley to Bonnybridge, the Green Rig area, and the southern edge of the Growth Area.
- 2 Areas composed mainly of large, moderate and steep slopes: i.e. Darroch Hill area.
- 3 Areas composed mainly of medium sized, flat and moderate slopes: from Ainsgath Hill round the Growth Area to Torwood.
- 4 Areas composed of small, flat, moderate and steep slopes: Larbert and Polmont areas.
- 5 Areas composed of medium sized, steep slopes: the edge of the raised beach, and the Carron and Avon Valleys.

## NATURAL DRAINAGE

There is a very close relationship between "drainage" and "slope": the former continuously changing the topography by processes of erosion and sedimentation; and the latter influencing the direction and rate of water flows. Thus the Map 6, "Orientation of Slopes" shows the general direction in which surface water runs, e.g. water on north facing slopes going northwards; and the Map 5 "Slope Analysis" indicates the rate at which it flows, e.g. water on



Map No. 3: Location of Growth Area

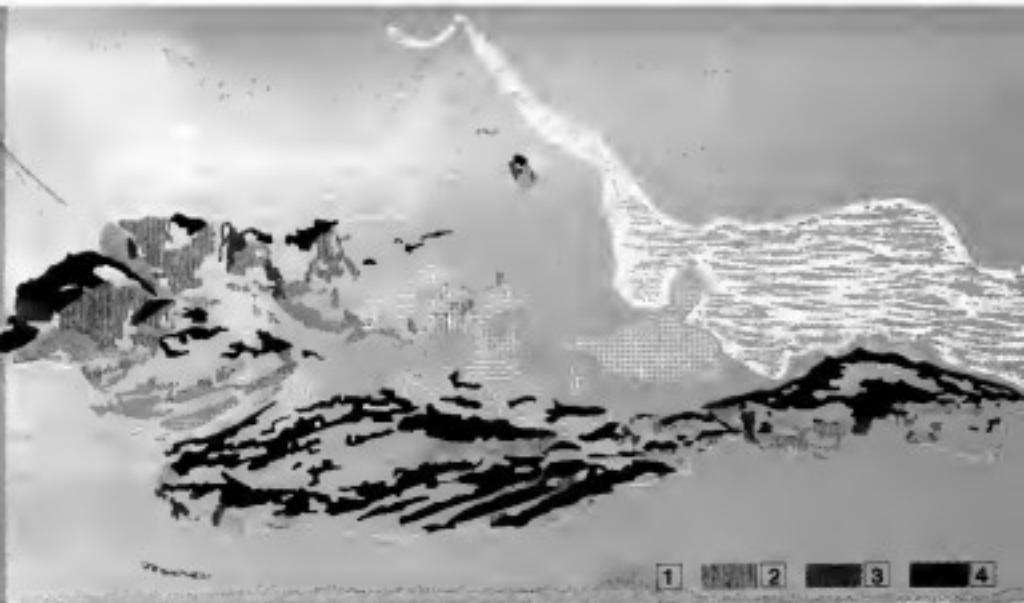


Map No. 4: Relief



Map No. 5: Slope Analysis

Key: 1. Moderate, 1.8 to 1.20. 2. Steep, 7.5 and over.



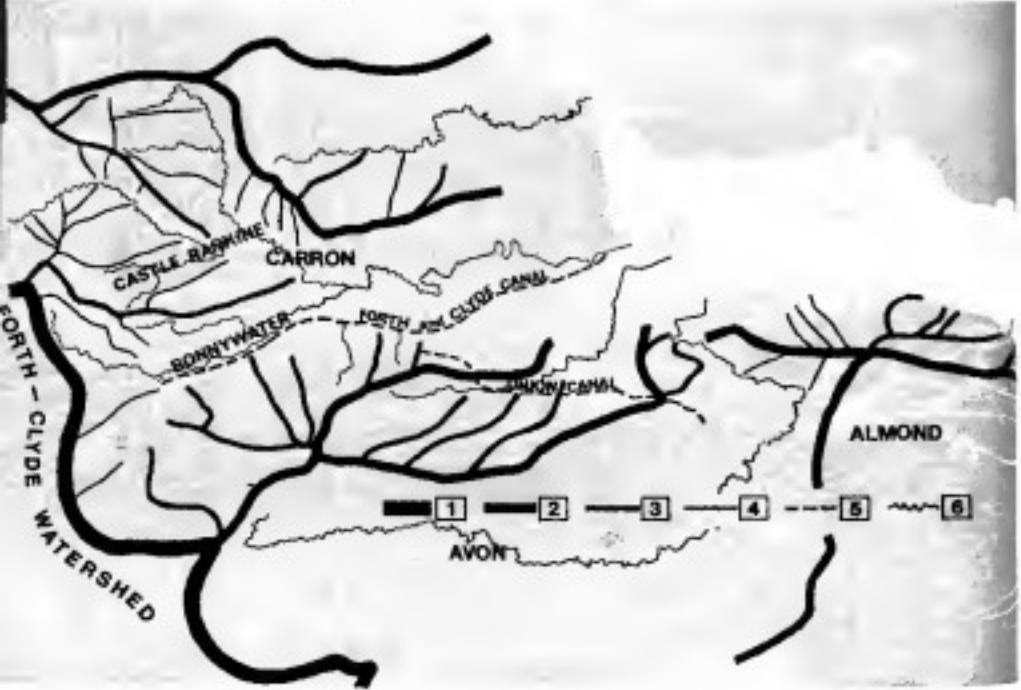
Map No. 6: Orientation of Slopes

Key: Orientation: 1. South. 2. East. 3. West. 4. North.





Map No. 7: Morphological Types



Map No. 8: Natural Drainage

Key: 1. Watershed—2. Principal, 3. Secondary, 3. Thrid Class- 4. Fourth Class. Water—5. Canal, 6. River.



Photo 1: River Carron near Carseochans

steepest slopes flowing fastest. An area's natural drainage may be described as a hierarchy of catchment basins, each defined by its watershed and containing a principal drainage channel and collector system of tributaries.

#### *Basins and Channels*

Poor classes of catchment basin and their respective channels have been distinguished.

The principal basin influencing the whole Growth Area is that of the Firth. Its watershed with the Clyde forms part of the Atlantic-North Sea divide, and lies to the south-west of the Region (see Map 8, "Natural Drainage"). The Firth Estuary, into which it drains, and which forms the Growth Area's north-east boundary, is tidal, and by dredging is maintained as a sea link to the port of Grangemouth.

Secondary catchment basins of importance to the Growth Area are those of the Carron and the Avon, both draining directly into the Firth of Forth, and both subject to tidal influences over their lower reaches. That of the Carron covers approximately half the Growth Area, extending beyond its boundary, while that of the Avon lies almost entirely within the Area, but discharges through it, by way of the Avon Gorge. For a large part of its way through the Area the River Carron meanders across relatively flat ground, which results in occasional flooding.

The third class of basin includes those drained by the tributaries of the Carron, i.e. the Bonnywater and Cuninghame Burn; also the Powburn and Grangeburn, which discharge directly into the Firth.

The fourth class are small areas identified with minor burns and streams which may discharge directly into the Firth, or into secondary channels and their tributaries.

The drainage pattern and rates of run-off in an

area are affected by the degree of slope, permeability and water holding capacity of the soils, the vegetation, and the climatic regime, and a combination of these factors may result in "areas of poor drainage" and "areas liable to flood".

#### *Areas of Poor Drainage*

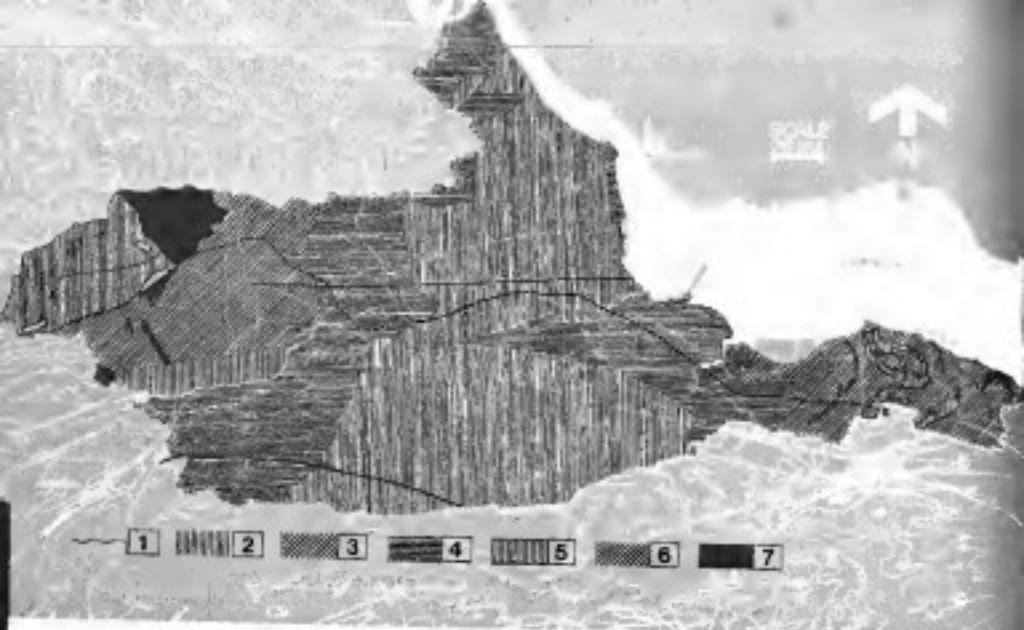
Nearly all the clay soils in the Growth Area present drainage problems. On sloping ground their impermeability causes rapid run-off (sooth of Falck); in hollows they may cause permanent flooding and the formation of peat (Cairnessay); on level ground they cause waterlogging, and may aggravate conditions created by a high water table near sea level (the marshes). On the fenshows there are extensive mudflats between high and low water mark, where the accumulation of silt is slowly raising the surface level.

#### *Areas Liable to Flood*

The worst areas of this type are shown on the Map 8B "Rehabilitation". They are generally on the low flat ground adjacent to streams and rivers. Grangemouth is liable to flooding when the Grangeburn, crossing the flat ground, cannot discharge all the water descending from the upper slopes.

## GEOLOGY

The geology of the Growth Area has been divided into "Solid" and "Drift". The former covers the rocks from the earliest identifiable period about 300 million years ago; and the latter deals with the very young rocks, gravels, sand and other deposits which have collected over them within the last million years. The geological history of the Growth Area is a combination of simultaneous and sequential processes and events; of chemical and physical changes



Map No. 9: Solid Geology

Key: 1. Line of Geological Section AB 2. Productive Coal Measures 3. Oil Shale Group  
4. Millstone grit series 5. Extensive rock 6. Limestone coal measures 7. Intrusive rock

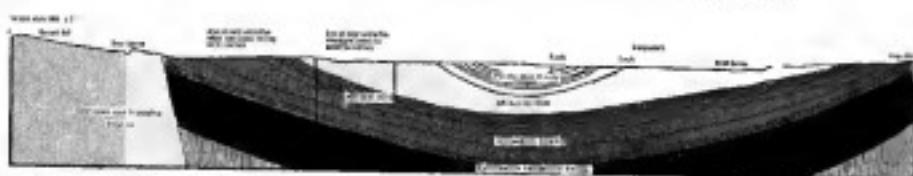


Diagram N: Geological Section along line AB

due to moisture, temperature, and pressure influences on the rocks; of sediments being laid down, raised, folded and eroded.

#### Solid Geology

Scotland's Midland Valley probably started to evolve towards the end of Silurian times about 300 million years ago. In the Valley, the sediments of the Ordovician and Silurian seas were deposited, compressed, folded and worn down. During folding, lateral pressures shaped the rocks into ridges on a N.E.-S.W. axis. Several major depressions were formed, one of which lay along what is now the Midland Valley.

All six rock-types of the Growth Arcs were deposited during Carboniferous times which started 280 million years ago when a warm climate associated with lagoonal conditions produced a luxuriant vegetation. As each successive climate developed, particular rock types were formed and deposited in layers above each other. (See Map 9 "Solid Geology").

#### Oil Shales

The oil shales were formed first, under warm shallow seas.

20

#### Limestone Coal Measures

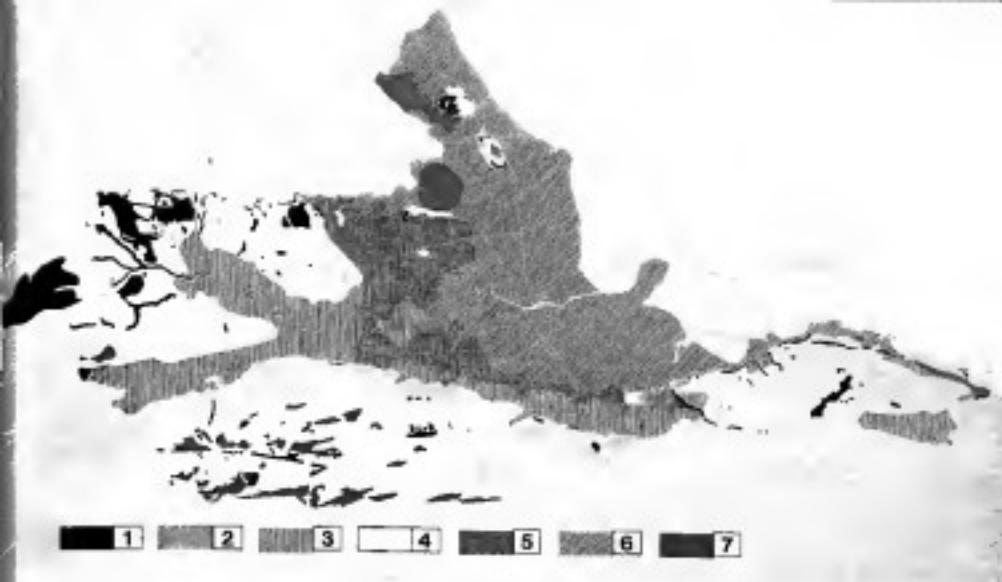
As the sea gradually retreated, large lagoons were formed which supported a luxuriant vegetation in a hot and humid climate. Undergoing pressure from succeeding layers of sediment, the remains of the vegetation eventually formed the first coal seam, originally covering the entire Area. In the contemporaneous bogs and swamps, iron in solution was precipitated and accumulated in thin bands, so associated with the coal seams. These "ironstones" eventually provided the first supplies of local ore to be used by the iron works at Falkirk.

#### Millstone Grit Series

The Area was then subjected to further earth movements which elevated the land to the north east in the region of Scandinavia. It is probable that a new river system developed on this surface and carried its debris from the far north to deposit clay and pebbles in a delta which completely covered the whole Area. This debris, later consolidated, formed the Millstone Grit Series in which fireclay deposits are found.

#### Productive Coal Measures

A return to conditions similar to those existing



Map No. 18: Drift Geology

Key: 1. Rock. 2. Extraction rights. 3. Sand and gravel. 4. Boulder clay. 5. Silt clay and gravel. 6. Clayey sand and silt. 7. Peat.

when the limestone coals were formed, resulted in the development of other coal measures above the Millstone Grit.

#### Intrusive and Extrusive Basins

The Carboniferous period was also one of intense volcanic activity; lava erupted, flowing over and between contemporary rocks. These respectively are the extrusive basins which form Darrock Hill, and the intrusive basins which occur in this band through the coal seams at Bo'ness.

Crustal disturbances marked the close of the period during which all the rock strata were folded and faulted. (See Diagram II "Geological Section"). The horizontal stratification and much of the different rocks was shaped into a basin with the oldest rocks coming to the surface at the edge of the basin, and the youngest rocks on the surface in the center. Thus the early limestone coals extended under the Aces from west of Denny, where they dip down andwards below the later rocks, to Bo'ness where they rise again to reappear on the surface.

#### Drift Geology

The deposits which now cover the Growth Area are mainly the result of physical changes within the last million years. Their great variety is due to two agencies, ice and sea, which have dramatically shaped the landscape.

The Ice Age was a sequence of cold and warm periods, in which the Growth Area was covered at least three times by great depths of ice. Under its movement mountains were rounded off, and the former river valleys of the Forth and Carron were granged and straightened out. The whole land mass was also depressed by the weight of ice, so that when it melted, the sea level was about one hundred feet higher than it is today. On the removal of this weight

the land began to rise again to its present level. As this process was erosive, a succession of "nested" beaches or terraces was formed whenever mean sea level was steady for a long period. An impressive example can be seen between Blackness and Falkirk where the edge of such a beach rises sharply from the flat plain.

The deposits have been classified largely by their particle size, and their distribution is shown on the Map 18 "Drift Geology".

#### Boulder Clay

When the ice sheet melted at the end of the Ice Age, it deposited the rock fragments which had been collected and ground up as the ice advanced. This mixture of fine clay particles and rounded stones still covers or underlies most of the Growth Area.

#### Sand and Gravel

While the ice was melting, rivers ran over, through and beneath it, washing down sand and gravel which was later deposited at the edges of the ice sheet. In some cases these rivers became choked with debris, and new farm long ridges (or kames) and mounds. These land forms (particularly noticeable in the Polmont area) contain commercial quality sand and gravel. The Rivers Carron and Bonnywater have cut through and removed much of the original debris, although important deposits still remain along their banks.

#### Silt Clay and Sand

This mixture of finer particles is the result of the combined action of ice and sea. It occurs in a band between the sand and gravel deposits and the Clayey clays, producing a very gentle relief.



Map No. 11: Soils. Key: 1. Clayey tills. 2. Sandy loams. 3. Silty clays. 4. Peat.

1 2 3 4

### The Carse and Salt

While the sea was fluctuating between minus 400 ft. O.D. and 100 ft. O.D., it deposited clays and silts along its shore, similar to the existing mudflats. These fine sediments, which overlie a layer of boulder clay, vary in depth at over two hundred feet. They are the subject of a special study by J. B. Stansbie. (See Appendix 1.)

### Peat

Peat is an organic material, consisting of partly decomposed plant remains. It developed over large areas of poor drainage in the Growth Area, but is now limited to parts of the Carse (Letham Moss and Dunmore); the Slamannan Plateau; and Durroch Hill.

On the Carse, it has in some cases been overlaid by mineral deposits.

### Soils

Soils are developed primarily as a result of the relationship between drift deposits and climate. The drift and its sources have already been discussed; climate is covered in the next section. The different combinations of these factors produce characteristic vegetation, which in turn tend to modify the soils on which they grow. Further changes may also take place after drainage, cultivation, cropping, liming, etc. Analytical studies of drainage qualities, parent material and particle size show that there are sixteen types of soil in the Growth Area, which may be broadly divided into clayey tills, sandy loams, silty clays and peat. See Map 11, Soils.

### Clayey Tills

These soils are derived from boulder clays and are generally of a very impervious nature. They are found in the hillier areas, i.e. Airliegate Hill, the edge of the Slamannan Plateau, the Campsie Fells and Terwood. Under suitable climatic conditions and intensive site drainage they have, or can become good quality agricultural soils.

### Sandy Loams

These soils may be derived from boulder clay, or be fluvi-glacial or alluvial in origin. The percentage of sand and gravel which they contain produce many gradations of texture and workability. They are mainly found on the lower hill slopes, along the valleys of the Carse and Bonnywater, and in the transition zone between the flat upland and the hills where they support a fertile arable agriculture and intensive horticulture.

### Silty Clays

The Carse clays comprise this group. They are derived from estuarine deposits in a similar way to the adjacent mud flats; and after ditching and dewatering have become among the most productive agricultural soils in the country. Owing to their impermeable nature, flatness, and nearness to sea level, they have a high water table and are liable to flood.

### Peat

The areas of peat in the Growth Area fall into two types: those on the Carse near sea level, and those on the Slamannan Plateau and in the Campsie Fells. The former are being afforested, as at Dunmore, or worked, as at Letham. The latter are mainly rough pasture for sheep and cattle.

### CLIMATE

Climate is one of the basic physical elements of the natural environment, exerting an influence on nearly every human activity, and over a wide range of biological and physical processes. It can be regarded as a summary of the shorter term weather conditions observed over a long period of time, for any particular place; and may be considered and expressed as a number of separate but interdependent elements: temperature, sunshine, wind and rain. These elements occur in different combinations, producing a variety of weather conditions.



Map No. 12: Rainfall (inches per year)

Since there are no stations with continuous records within the Growth Area, climatological statistics have been drawn from Stirling (representing the optimum conditions of the low lying sheltered areas); and Cawdor (representing the more rigorous conditions found on the plateau). Interpolations from these two extremes can be made if allowances are made for local variations. The dominant meteorological factors were: temperature, rainfall and wind.

The general climate of the Growth Area can be attributed to the modifying influence of the Atlantic and North Sea which tend to produce mild and wet conditions. These are modified by the influence of the Highland massif (occasionally resulting in severe winter conditions), and its topography (basin-like with a high plateau, and a pattern of W.S.W. valleys), which produces extremes of temperature and exposure.

#### Temperature

Due to its nearness to the sea and its basin shape which backs up quickly, the Firth Valley is on average one of the warmer places in Scotland. Since there is a very close relationship between climatic conditions favourable to plants, and those suitable for human comfort, studies have been based, not only on the climatological statistics of areas, but also on their vegetation.

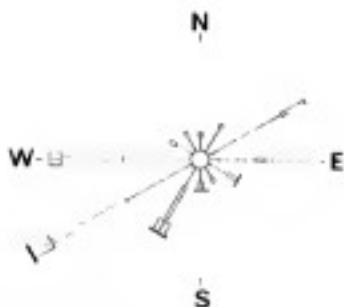
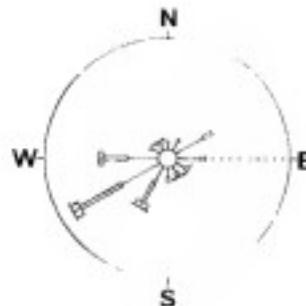
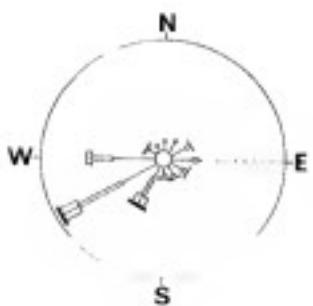
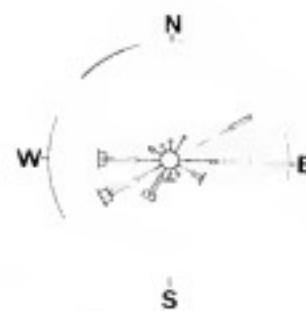
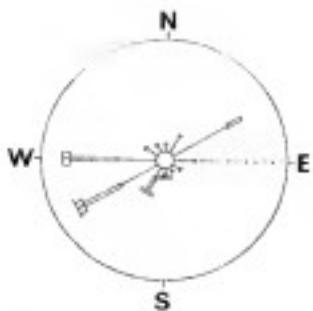
Map 20 "Landscape Analysis" shows the present limit of both fertile soils and tree growth.

South and west of these limits, temperatures are considerably lower than in the more favoured areas. The length of growing season for any area can be assessed from the number of days per year which have a daily mean of over 42° F.

Table 1 shows that Stirling, which is typical of the lower parts of the Growth Area, has nine months with growing days compared with Cawdor, which is typical of the higher areas, and has only seven.

TABLE 1: Averages and Extremes of Air (Shade) Temperature (F°)

STERLING	J	F	M	A	M	J	J	A	S	O	N	D	Year
Average Daily Max.	48.1	48.9	48.0	59.0	59.9	64.9	67.1	66.9	61.9	54.1	48.0	44.4	54.5
Average Daily Min.	33.5	33.6	35.1	39.2	43.3	48.9	52.9	52.0	46.4	43.5	37.5	33.2	41.9
Average Daily Mean	37.2	38.7	42.1	46.6	51.6	56.8	59.7	59.0	54.9	48.9	42.8	36.7	46.2
CARNSWATH													
Average Daily Max.	38.6	42.9	49.6	50.7	57.1	62.1	64.3	63.3	58.9	53.2	45.8	41.1	51.9
Average Daily Min.	29.9	30.1	32.7	35.6	39.4	44.8	48.4	47.5	44.6	40.1	35.1	32.3	38.5
Average Daily Mean	34.3	35.5	39.3	43.1	48.3	52.5	56.3	55.4	51.7	46.1	40.5	37.2	45.1



#### **TURNHOUSE AIRPORT**

EDINBURGH, during the five year period 1957-61, from observations at 00, 0300, 0900, 1200, 1500, 1800 and 2100 hrs. g.m.t.

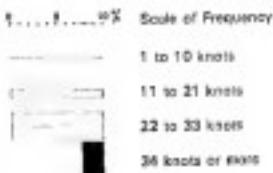


Diagram IV. Frequency, Speed and Direction of Wind

### Rainfall

Carnwath was not considered as representative of the uplands' rainfall characteristics, and was not included in rainfall statistics. Three stations were however selected on which to base the analysis: Falkirk, Grangemouth and Denny Reservoir.

These statistics indicate that the western areas tend to have two peak months of rainfall, October and January, while the rest have only one, in January. The driest month in all cases is April; the dry period being longest in eastern areas, e.g. Grangemouth has less than 2.5 inches per month from February to June. On average, no part of the Area has less than 30 in. of rain per year, while the minimum increases with altitude to an average of over 60 in. at 1,000 ft. above sea level. (See Map 12, "Rainfall").

### Snow

Snow falls on the low ground (0-200 ft. O.D.) on an average of twenty five days per year. Stirling at 151 ft. has an average of nineteen days per year; and Carnwath at 706 ft. has twenty nine. Generally the number of days in which snow falls increases with altitude by one day per year for every fifty foot rise. Above 400 ft. O.D. deep snow cover, and associated drifting are likely to be a nuisance and in some cases even hazardous. There is a further increase in snow lying time on north facing slopes. Stirling on average has eighteen snow lying days per year compared with thirty-one at Carnwath.

### Fog

The low lying areas suffer considerably from fog, Stirling having an average of twenty days per year, as against Turnhouse with eleven and Carnwath with nine. They occur mainly from October to January.

### Wind

The wind regime in the Area is not easy to define because of the lack of data. In general it has been assumed that the wind statistics for Turnhouse will provide a reasonable guide for the lower lying and more open parts of the Growth Areas (see Diagram III, "Frequency, Speed and Duration of Wind"). In the north-west, the effects of westerly and north-westerly winds are likely to be suppressed in favour of south-westerly and northerly ones by the Campsie Fells; while on the plateau and its western flanks, the Turnhouse figures are likely to underestimate wind speeds. In general, wind increases with height, and will also significantly increase when it funnels through valleys, or flows over ridges. The prevailing winds are S.W. to W.S.W.

### Gales

The pattern of gales for Turnhouse, which represents the exposed area, is on average one day per month from March to June, less than one day per month for July and August, one day per month from September to November, two days per month in January and February, and three in December giving a yearly average of fourteen days. Stirling, being shielded from the west and southwest by the Campsie Fells, has on average only three days with gales per year and represents the sheltered area. Interpolations from these extremes can be made if allowances are made for local relief.

### Sunshine

Since there is no sun recorder at Carnwath, statistics for a comparable area at Balerno have been substituted.

The interesting point here is that although the high areas have more rain, lower temperatures and more wind, they may have more sunshine. North facing slopes, which are prevalent in the Growth Area, will enjoy less than average sunshine.

TABLE 2: *Averages of Rainfall for the Standard 35 Year Period 1916-1950*

Inches per month and year

Place		Alt.	J	F	M	A	M	J	J	A	S	O	N	D	Year
Grangemouth Park ..	157' o.d.	4.0	2.6	2.1	1.9	2.5	2.1	3.1	3.1	3.6	3.0	3.6	3.3	3.0	33.9
Falkirk .. ..	125' o.m.	4.1	2.9	2.4	2.1	2.6	2.3	3.2	3.4	3.2	3.9	3.6	3.5	3.2	37.2
Little Denny Reservoir	328' o.s.	5.2	3.7	2.9	2.6	3.0	2.8	3.7	4.3	4.3	5.2	4.7	4.6	4.7	46.7

TABLE 3: *Estimated Averages of Sunshine Duration (30 Years) in Hours*

STIRLING	J	F	M	A	M	J	J	A	S	O	N	D	Year
Average Monthly Total Duration ..	41	74	100	147	180	186	183	135	120	85	49	31	1,312
Daily Mean ..	1.32	2.63	3.22	4.09	5.79	5.21	5.25	4.60	3.99	2.73	1.65	1.00	3.59
BALERNO													
Average Monthly Total Duration ..	46	69	101	140	185	187	156	139	115	88	51	37	1,314
Daily Mean ..	1.45	2.48	3.21	4.07	5.91	5.26	5.10	4.48	3.82	2.64	1.72	1.08	3.60

## PLANNING IMPLICATIONS

### Relief

Land with a gradient of 1:6 and more incurs increased site preparation and foundation costs, and therefore is in general unsuitable for development.

Those areas of slopes between 1:6 and 1:20 can be developed within acceptable cost limits, and in general will be suitable for residential and smaller scale industries. The flat areas are the most economical from a site preparation point of view, and will be particularly suitable for large scale industries.

As large flat sites, particularly with good communications and water, are rather scarce, they should not be developed by smaller industries which could be placed elsewhere, but reserved for major industry.

South facing slopes are warmer and brighter, and will be particularly suitable for residential development.

North facing slopes are colder, damper and duller, and will be less suitable for residential development.

The steep slopes of linear form may be useful as boundaries to development, or as part of a pedestrian - recreation system.

### Natural Drainage

Gravitational sewage systems follow natural drainage patterns, and watersheds may therefore act as boundaries, or "thresholds" for urban development.

Watersheds tend to define "areas of visual containment", giving them "identity"; they may therefore help to determine the traits of urban development.

Watersheds also define the catchment area for reservoirs, and may therefore determine those areas which should be kept free from development to prevent pollution.

Streams, rivers and canals may act as barriers or boundaries to urban development, and may become important links in a comprehensive recreation system.

Breeding water is needed as a diluent of effluent, and for industrial purposes, rivers and the sea will influence the location of sewage works and infrastructures.

Some areas are liable to flood or have a high water table, and will therefore be unsuitable for development unless improved by channel widening and deepening, embankment, river straightening, ditching, pumping and in-filling.

The possibility of future coal mining, and subsequent subsidence in those areas affected by a high water table, may cause damage conditions to deteriorate, making it more difficult for development.

Areas of water have immense recreational potential and the Firth of Forth and the numerous lochs and reservoirs may be developed to become valuable assets to a comprehensive recreation system.

The extensive mudflats are potentially very fertile and may be suitable for reclamation and development for agricultural purposes. They may also be used as tipping areas, and reclaimed for industrial or recreational use.

### Solid Geology

There are many outcrops of the Productive and Limestone Coal within the Growth Area. The majority of them have been affected by shallow workings which may result in serious ground support problems.

The Millstone Grit contains fireclay deposits, and past, present and future workings may result in subsidence.

Because there are extensive areas underlain by workable Limestone Coals, widespread ground support problems may result from future N.C.B. workings.

### Drift Geology

Mineral workings, and concession areas in the sand and gravel deposits may restrict development. These areas may however be rehabilitated by tipping and other means and subsequently returned to agriculture, or may be developed for recreational, industrial or residential use.

Valuable deposits of sand and gravel may be found in the Growth Area as a result of current surveys, and urban development may therefore be prevented or deferred until after they have been extracted, and the areas rehabilitated.

Because of the uncertain bearing capacity of the Cane clay, silt clay and sand altuvium, urban development may not be feasible where they occur, and detailed site investigations will therefore be necessary.

Boulder clay and rock in most cases have a high load-bearing capacity, which will be suitable for heavier and multi-storey structures.

Peat has a low load-bearing capacity and these areas will therefore be unsuitable for development unless costly excavation can be justified. They may however provide suitable sites for peat extraction, afforestation, nature reserves, or recreation areas.

### Soils

The areas of clayey soils below 600 ft. O.D. are at present in the "Poor" and "Non-Agricultive" agricultural class, and may have a potential for improvement.

The sandy loams in the Leaburn area may contain commercial quality sand and gravel, the extraction of which may deter urban development until site rehabilitation.

The silty clays of the Carse are very fertile, and there will be a substantial loss of agricultural productivity if they are developed exclusively for urban purposes.

The peat areas are unlikely to be of immediate value for agricultural improvement and may therefore be developed for forestry, or recreation, or maintained for scientific purposes.

### Climate

Mean temperatures do not fall below tolerable limits anywhere in the Growth Area, and will not be a critical factor in the selection of sites for urban growth.

They are however higher at lower altitudes, and areas below 400 ft. O.D. are more favourable for residential development.

South facing slopes are warmer, and sunnier areas above 400 ft. O.D. with a southern exposure may be suitable for residential development.

Rainfall is greater at higher altitudes, and areas above 500 ft. O.D. will be less suitable for residential development.

Because snow lies longer on north facing slopes, they will be less suitable for urban development.

The general severity of some areas will be reduced because of wind exposure. Land over 600 ft. O.D., which does not have higher ground to the west, all land over 600 ft. O.D., parts of the Carse without trees, e.g. Skelmorlie.

To prevent pollution, flats over three to four storeys in height should be more than half a mile from chimneys of the same height.

In valleys which run parallel to the prevailing W.S.W. wind, tree planting and special architectural design will be needed to reduce exposure levels.

On north facing slopes, special precautions will be needed to keep roads free from snow and ice, especially in the busier and steeper sections.

## 2. Land Uses and Environment

### SETTLEMENTS

Volume One of this Report has already given the general background to the location of the Growth Area geographically and historically, and has discussed the urban settlements and their growth. These studies show that there are problems of industrial imbalance, unemployment, inadequate housing provision and traffic congestion. This section completes the joint study with a description of the general character of the urban settlements, in terms of civic design and land-use relationships. It also indicates some important influences affecting the built environment.

#### Settlements in the sub-regional context

The Growth Area occupies a geographically advantageous position in Central Scotland where communications interconnect: road, rail, canals and port facilities. It developed originally as an agricultural and marketing region, and then became an extension of the coal mining and industrial belt. Urban development started mainly from the late eighteenth century and has expanded to form a series of scattered settlements of varying size and character. Several parts of the Growth Area contain interesting historical features ranging from Roman remains and significant achievements of the Industrial Revolution to buildings of archaeological interest of many periods. (See Map Nos. 13 and 14a to 14d showing historic growth.)

The present distribution of land use is given in Table 1, with acreages rounded off to significant figures.

TABLE 1: Existing Land-Uses (Acres)

Residential (net)	Industry (excluding docks)	Recreational open space (incl. golf courses)	Other Uses	Golf Courses and Docks	Total
3,200	1,600	1,350	1,325	725	8,300

Overall gross density for urban areas only is sixteen p.p.a. (sixty three acres per thousand population). Overall gross density (including docks and golf courses) is fifteen p.p.a.

Although the urban areas are not intensely developed, an increasing demand for new sites for industry and housing is hastening the disappearance of open spaces within the Burghs as well as encroaching an encroachment upon the surrounding agricultural land. Proposals have already been made to develop most of the vacant pockets of land within the built-up area where the Burghs strive to preserve their separate identities. The urban scene generally consists of one or two storey dwellings (the former often traditional cottages or miners' rows) with the years of depression between the Wars spawning housing of mean appearance with frontage layouts of monotonous regularity; post-war housing, unfortunately, has been rarely more successful. However, isolated pockets of mid-twentieth century housing provide evidence of the growth potential of this Area. Materials are traditionally stone and slate, but council housing is often rendered. Unfortunately, the effects of weathering and atmospheric pollution have reduced many buildings, new and old, to an overall rather depressing grey, and as in other places many residential areas suffer from the intrusion of the motor vehicle.

The focus of most settlements is the "High Street" or "Main Street" where the traditional scale usually survives, and heavy traffic causes congestion, noise, nuisance and danger. These centres of social and business activity are seldom without their adjoining areas of blight.

Industry is generally scattered throughout the Growth Area, with the exception of Grangemouth where there is a heavy concentration. Where concentration occurs, the effects of pollution and heavy traffic are obvious, especially in residential areas. Views are often dominated by unsightly industrial buildings; nevertheless, an atmosphere of industry and bustle is evident in all areas but especially around the docks and centres of Grangemouth and Falkirk.

In the countryside, there are many pleasant wooded areas but in the urban areas trees are found mainly in the many formal open spaces. Adjacent to and sometimes within Burghs, there are areas dominated by high tension overhead electricity cables and tall pylons. Other vertical features disturbing distant views are the industrial stacks and cooling towers in Grangemouth. There are dramatic views across the Firth towards the Kintyre hills from the outskirts of most towns.

#### Character

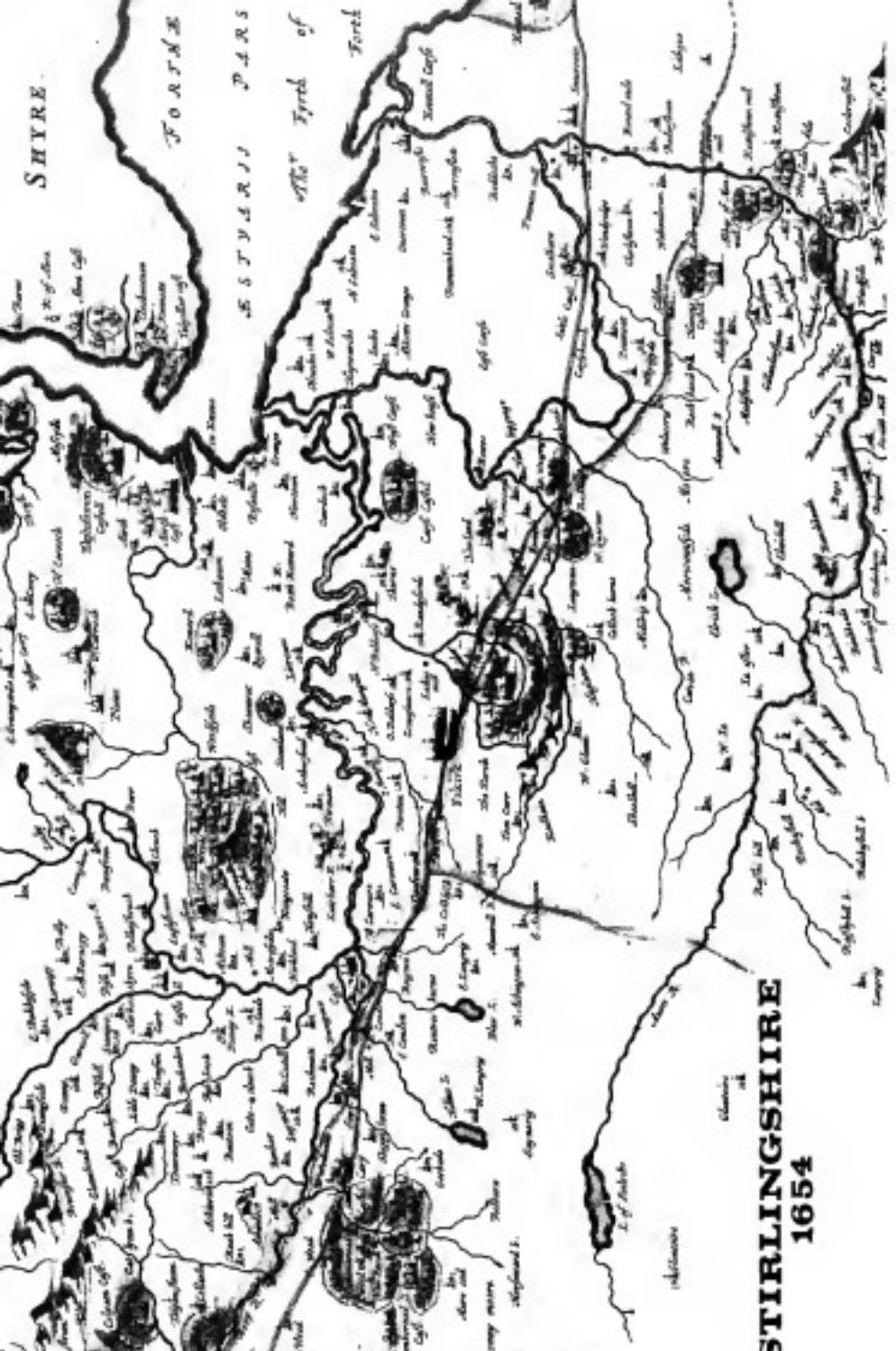
##### Falkirk

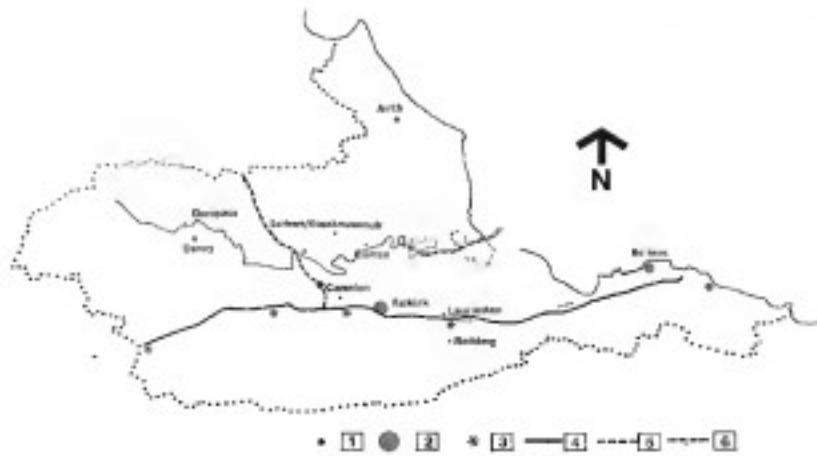
From very early beginnings, Falkirk has been the centre of the Growth Area and was made a Burgh of Regality in 1646. The Burgh is twenty-six miles from Edinburgh, twenty-three from Glasgow and eleven from Stirling. Agriculture and cattle market-

ing have also helped to promote a substantial commercial and shopping centre. The Carron Company Ironworks (founded in 1709), promoted Falkirk as a centre of metal manufacturing industries; more recently there has been an expanding diversification, but an increasing number of week journeys are to Grangemouth only three miles distant.

The commercial centre, a series of twisting streets on a ridge of high ground, contains several dignified buildings in stone and slate which are of architectural merit. New shops are no longer converted from existing domestic buildings, but designed for their specific functions, often with the offices above. The ancient Steeple punctuates the skyline from afar and is a focal point where the High Street widens at a busy traffic junction. Another focal point, at the western end, is the parish churchyard, an attractive well-planned space, opening into the shopping street. There are two other smaller shopping centres at Grahams Road—Carron Road, and Main Street, Camelon. The major "through" traffic route in the Area, which runs through the centre, causes congestion, but the range of shopping facilities sometimes attracts such large numbers of shoppers that the carriageways are taken over by pedestrians and the traffic brought to a standstill; proposals are in hand for pedestrianisation. Development behind the shops has very mixed uses, including many service indus-

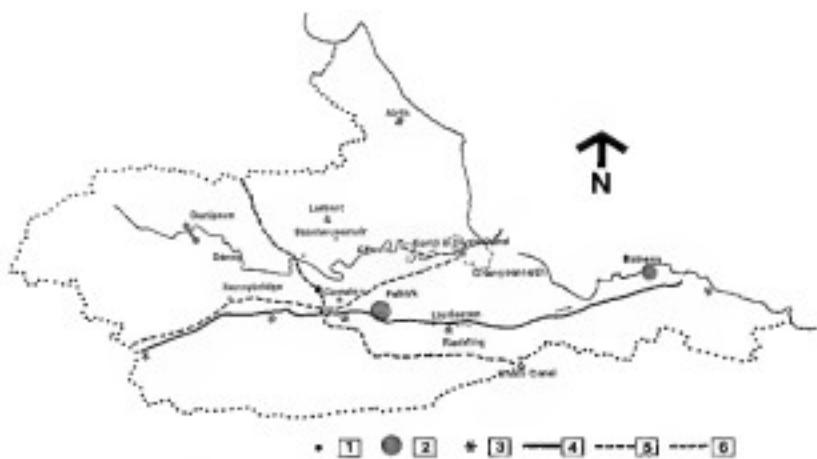
# STIRLINGSHIRE 1654





Map No. 14a: Historic Growth—From the Roman occupation up to 1760

Key: 1. Roman City 2. Settlements 3. Roman Fort 4. Line of Roman Wall  
5. Line of Roman Road 6. Canals



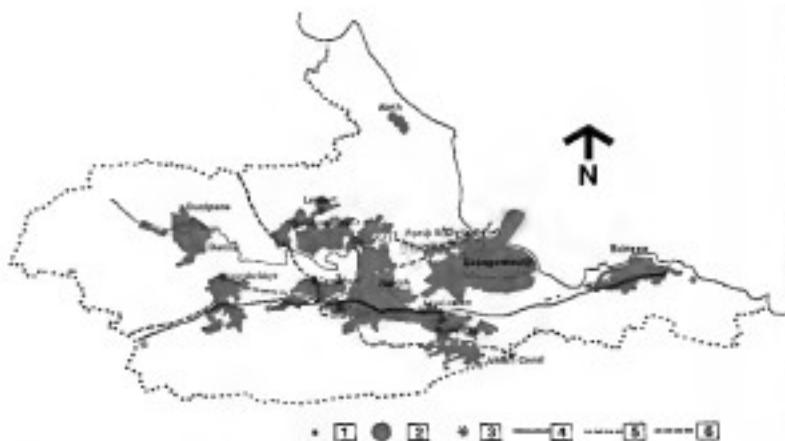
Map No. 14b: Historic Growth—Up to 1880

Key: 1. Roman City 2. Settlements 3. Roman Fort 4. Line of Roman Wall  
5. Line of Roman Road 6. Canals



*Map No. 14c: Historic Growth—Up to 1900*

*Key: 1. Roman City. 2. Settlements. 3. Roman Fort. 4. Line of Roman Wall.  
5. Line of Roman Road. 6. Canals.*



*Map No. 14d: Historic Growth—Up to 1965*

*Key: 1. Roman City. 2. Settlements. 3. Roman Fort. 4. Line of Roman Wall.  
5. Line of Roman Road. 6. Canals.*



Photo 2. Central Area, Folkestone, looking west [copyright Aerialmap]



Photo 3. High Street, Falkirk

tries; areas ripe for development lie to the south. A brewery occupies an extensive site in the town centre and presents problems of appearance and pollution.

Land uses are mixed in the northern part of the Burgh and the Brainsford area in particular suffers virtual isolation among industries which produce pollution and noise. Most of Falkirk's industries manufacturing metals are concentrated in the northern half of the Burgh. There is also a concentration to the south-west (mostly property in poor condition) where atmospheric pollution is serious.

The Growth Area's two Canals do not enhance the urban scene. The Forth and Clyde Canal runs mainly through industrial areas and constitutes a barrier between the north and south. However, its lock gates, etc., are interesting examples of engineering of the late eighteenth century. The Union Canal, to the south of the Burgh, runs partly in tunnel and is more attractive. Two main railway lines and many sidings disrupt the urban pattern but they provide Falkirk with excellent railway services.

The major residential areas extend to the west and south, the latter contained by steep slopes, with views of the hills beyond. Attractive housing is situated just south of the centre: large detached dwellings in well-wooded grounds. Other types of housing range from attractive traditional "rows" to very recent Local Authority schemes. Several hospitals have been built on prominent sites throughout the southern area.

The largest of several areas of open space is Callendar Park which contains an historic house having associations with the '15 and '45 rebellions, Mary Queen of Scots, etc. The Park covers several hundred acres of rolling grassland with fine mature trees: a splendid asset to the Growth Area.

Notable new development includes a small newly-opened two-level pedestrian shopping precinct, visually dominated by an hotel tower at Callendar Riggs; Falkirk's new Council Offices, west

of the centre, are of a very high design standard: a worthy symbol of Falkirk's importance in the Area; at the west end of Callendar Park several fifteen storey high tower blocks of flats are being built. These give further vertical emphasis to Falkirk, and, though of low overall density, they are by far the tallest residential structures in the Growth Area.

There is an extensive area of vacant land within the Burgh, adjacent to the River Carron where tipping is in progress and sand and gravel are being extracted; another in the east borders the shared green belt, which is nearly "closed" at one point by almost continuous development westwards from Grangemouth. Falkirk is separated from Stenhousemuir only by the river.

#### Grangemouth

In Grangemouth there are striking contrasts between the extreme flatness of the land and the vertical elements of the vast industrial complex. The oldest part of the town, founded in 1790 around the then new port, is almost derelict with the gridiron pattern of streets rapidly being obliterated by demolition. Some elements are however of historic and architectural interest, particularly because of their association with pioneering work in building steamships. The port owes much of its importance to its location which is equidistant from Edinburgh and Glasgow; as well as to the extensive oil refinery, and the petro-chemical and dye industries located at Grangemouth. However, much of the heavy road traffic to the docks passes through residential areas causing noise, nuisance and danger. A large proportion of workers in these industries travel from other areas.

The residential area is comparatively small and almost surrounded by industry, its dwellings are mainly two-storey post war Local Authority built, with more recent accommodation having a high



Photo 4. Grangemouth, looking north (copyright 'The Statesman')

percentage of flats and maisonettes, blocks being a maximum of five storeys. Most areas suffer at times from varying degrees of air pollution, some housing being very close to industrial development. House building is progressing rapidly at relatively high densities, but available housing land is very limited. There is only one major open space. An ambitious new shopping centre is designed, and about to be built at the present commercial centre focused on Lumley Street, in conjunction with an extensive urban renewal scheme.

The most notable example of the many new developments in Grangemouth is the Charlotte Dundas Scheme of mixed (medium and low end) housing, incorporating a high degree of pedestrian-vehicular separation with a small shopping centre situated at the west end around a pedestrian precinct. A new sports stadium has recently been opened nearby.

#### *Bo'ness*

The economy of this very old industrial settlement (made a Burgh of Regality in 1668), grew from extensive coal exports. Its urban form has been largely influenced by the extreme differences in levels between the flat foreshore and the top of the raised beach. There are excellent views across the Firth and to Grangemouth from all levels. Most of the town is on north-facing slopes and sunlight is restricted during the winter months. The oldest and densest part of the Burgh is along the foreshore,

now mostly obsolete around South Street, the old town centre. Here the narrow streets make traffic circulation very difficult, and atmospheric pollution has accentuated the extent of obsolescence. It is already proposed to move the main shopping facilities to higher ground where they will be centrally located and more convenient for the expanding population.

Industrial land along the foreshore is now generally under-utilised with many acres lying derelict. The old harbour and dock are silted up and are no longer used commercially. At Kincellie, at the western end of the Burgh, a vast, ugly coal heap disfigures the urban scene, frequently making its presence more obvious by fumes and smoke. It is fortunate that the Grangemouth Council have recently acquired this eyrie for the reclamation of the mudflats along the foreshore.

Residential development progresses southwards up the steep slopes with access roads generally following the contours. The steepest land (unattractive for development) has been retained as open space, and provides almost a complete pedestrian route running east-west through the town. Several minor streets unsuitable for motor vehicles are maintained as footpaths, linking the different levels. Few of the traditional 'tenement rows' remain, the majority having been replaced by extensive L.A. housing. Several isolated houses on large grounds create a "garden suburb" character around Douglas Park. Many derelict sites and wasteground are



Photo 5. Pedestrian street to centre, Bo'ness

scattered throughout the Burgh. Of the new development, the most notable is the Grangegrove housing scheme on the foreshore, but there is little pedestrian/vehicular separation, and many dwellings face on to the adjoining main road. A small shopping centre at right angles to this road is quite attractive and offers good parking facilities for shoppers.

On the outskirts of the Burgh lies the historic Kinnel House, in the grounds of which James Watt built his improved steam engine in 1765. Adjacent to it is a very fine forest to which there is public access. Several other buildings of historic and architectural interest are to be found at Linlithgow, three miles away.

#### Denny and Dunipace

This settlement five miles from Falkirk consists of two agricultural villages which have recently expanded very rapidly especially around Denny, the dominant unit. The main street now joins them both. The parish church is in a dominant position on Stirling Street, the main shopping area, where the shops consist generally of converted cottages. The general area rapidly deteriorates at its extremities but a new centre is being planned for the L.A. and this will greatly improve the environment.

Industry lies mostly on the eastern fringe of the Burgh and includes extensive paper manufacturing firms. An iron foundry is also a particularly dominant feature in the Burgh. Sand and gravel are being extensively worked to the east. A modest industrial estate is flourishing here as a result of energetic Local Authority action.

Most of the residential areas are in the western half of the Burgh, flanked by a recently constructed by-pass which will ultimately connect Cumbernauld and Stirling. Little land is left for expansion within the administrative boundary. Housing layouts are "traditional" and mainly two-storey. The River

Caron and its tributaries which run through the Burgh to the open countryside have great scenic potential but suffer from pollution.

#### Larbert/Stenhousemuir

These two settlements have grown into one urban area which has not yet achieved Burgh status. It has developed in a linear form along a main route between two agricultural villages dating from the eighteenth century founded around important castle markets, and now extends southwards to the River Caron. Shopping facilities are scattered along the Main Street with a small group of shops at Larbert and a larger group at Stenhousemuir. Falkirk Centre is only two miles away.

Industry is generally located in two areas: by Larbert Cross to the west, adjoining the railway line (including a large notorious foundry); and to the south-east (the Caron Ironworks). Adjacent to the latter are extensive areas of industrial dereliction which contrast sharply with the Caron Dam in its attractive surrounding woodland.

Housing areas are mainly in the south (much of it Local Authority) where parts are dominated by overhead high tension electricity cables and pylons. Where planning has matured, housing areas served by landscaped cul-de-sacs provide a more attractive environment. The seventeenth century Stenhouse Castle now forms part of a new private housing estate.

To the north of the Main Street a large open space contains a cricket ground and golf course and further north are three large hospitals on extensive and very attractive grounds.

The small settlement of Carronshill (consisting mainly of Local Authority housing) has grown up near the Caron Ironworks. To the east Stenhousemuir is separated from Grangemouth by agricultural land and Caron village.

## Outlying Development

The smaller urban areas generally have their origins in mining activities which reached a peak early in the twentieth century and now provide homes for commuters. Those with interesting features are described below.

### Launceston-Brighton

A loose urban development stretches from Launceston to Brighton linked by Westquater, Polmont and Redding. This has a rural atmosphere because pockets of undeveloped land and open space have been left between them, due to the steeply undulating terrain.

### Launceston

In 1750 land was laid out for a planned village on the turnpike road between Edinburgh and Falkirk. Traces of the original layout around a small square can still be seen.

### Westquater

This area shows influences of the garden city movement in its spacious layout around a steep-sided wooded glen. An ancient doocot is retained within the scheme.

### Polmont

At Polmontbank is located an interesting private housing scheme designed in a series of cul-de-sacs with garage courts and play spaces. Other private housing development at lower densities has also been attracted to this area. The Union Canal, now in poor condition though still attractive, runs through the village at Polmont Station.



Photo 6: The Pineapple, Dunmore Park

### Dunmore Village

This is a notable Scottish example of the picturesque mid-nineteenth century hamlet situated at the edge of the Forest around a central green. Nearby in Dunmore Park there is a pineapple-shaped summer-house dated 1761.



Photo 7: Westquater



Photo 8. Airth Village

#### Bonnybridge

Only four miles from Cumbernauld, Bonnybridge developed around its foundries and brickworks; it lies on both sides of the valley formed by the Bonnywater. Development is limited to the north by the A676 road and to the south by the Forth and Clyde Canal. What is left of the older housing areas is largely derelict and adjacent to the main traffic route which runs through the small shopping area in Main Street situated at the bottom of the valley. Scattered housing development stretches to High Bonnybridge where it is dominated by extensive heavy industries. Air pollution is particularly bad here. Extensive Roman remains lie on the outskirts at Rough Castle in the east, and Castle Cary in the west, linked by the line of the Antonine Wall, which runs parallel to the Canal.

#### Shieldhill and California

These are the highest settlements (above five hundred feet) and are rather bleak and windswept. There are extensive views across the Area to the Kilsyth Hills and to the Stirlingshire Plains.

#### Haggs and Bonknoch

These are two small isolated pockets of housing divided by the A80.

#### Airth

The heart of this small rural village has been rebuilt in traditional style around the ancient market cross. It lies at the foot of a rocky outcrop dominated by Airth Castle which dates from the sixteenth-seventeenth centuries.

### SPECIAL ASPECTS OF THE ENVIRONMENT

Until recently, the character of urban settlements within the Growth Area has been mainly conditioned by the exploitation of its natural resources and the need to transport raw materials and finished products by canals and docks, the railways and more recently, trunk roads.

The introduction of planning legislation involving land-use zoning and standards for population densities, plot ratios, daylighting, open space and traffic, has transformed the traditional character of these settlements during the post-war era, overcoming in the process many of the associated inadequacies.

Subtler, often invisible character-forming influences need now to be understood and dealt with if the future character of these urban settlements is not to fall short of the expectations of tomorrow's society and its inevitable demand for an ideal environment. This study deals with some of the more important of these latter factors: atmospheric pollution; micro-climate; safety and noise.

#### Air Pollution

Atmospheric pollution is important as a factor affecting this environment for a number of reasons: it may endanger health; it may harm plants and indirectly animals; it may disfigure buildings; it may reduce visibility, obscuring desirable views and disrupting transport. Even apparently harmless manifestations of pollution (e.g. the sickly smell from a jam factory or smuts on washing), may have important psychological side-effects.

The main pollutants (smoke, grit, dust, and sulphur dioxide) enter the atmosphere in differing quantities depending on the type of fuel and method of combustion. Their control is complex and measures to reduce pollution from existing sources must



Photo 9. Industrial air pollution

be combined with constant care in anticipating the effect of new development to ensure that the growth of industry and population does not raise the level of pollution to a point where it becomes a persistent nuisance and a potential hazard to health. Practical measures taken in other countries are of particular interest. Poland, for example, recently introduced regulations limiting the types of development permitted within a stated radius of certain industries. These "Protective Zones" take into account that many towns are subject to a variety of wind conditions and that industry and residential development should not encroach upon each other.

Considerable concern has also been expressed in the U.S.A., particularly in the Los Angeles Bay Area where serious temperature inversions occur. Here, meteorological control is used and certain emissions are banned when persistent inversions are forecast. The latest measures proposed by the Environmental Pollution Panel of President Johnson's Science Advisory Committee include "taxing those who pollute the air, water or land", and studies to develop "new and cleaner ways of powering cars: the most rapidly growing source of pollution".

In spite of many recent steps taken to overcome these problems (the Clean Air Act, Building Byelaws, the Albat Act and the Motor Vehicles Regulations), Professor Page has commented: "some people are hopeful that pollution problems will no longer be serious in years hence. I think this is a wrong interpretation of a situation which is throwing up new problems all the time which supplant the old. Therefore town planners will have to become much more aware of the scientific issues involved if they are going to keep abreast of the new problems, rather than flatter themselves they have solved the old problems. For a start, there are going to be many more of us living on the same amount of land shortly, and this in itself will bring a spate of new town planning problems involving pollution".

In the Growth Area there is not only evidence of past pollution but a certainty of massive population and industrial expansion creating similar problems.

#### Air Pollution in the Growth Area

A study was undertaken of external evidence of pollution arising from industrial processes in the Growth Area: premises producing smoke, dust, grit and smell were plotted (see Map No. 89), revealing numerous sources scattered throughout the Area, with concentrations at Bonnybridge, Falkirk and Grangemouth. Most of these were close to housing, and consequently many of the older dwellings looked drab and depressing.

Local Sanitary Inspectors stated that a number of complaints had been made by local residents about factories (in particular iron foundries, and firebrick works), railways and burning bungs, and that efforts to deal with these complaints had met with varying success. Smoke Control Areas have however been set up covering 870 acres of Falkirk, 160 acres of Grangemouth and part of Stenhousemuir; many new houses outside approved zones have been constructed to "Smokeless Zone" standards.

Albat Inspectors maintain constant vigilance in the Growth Area, particularly in Grangemouth, to ensure that pollution does not approach levels which might prove injurious to health. Studies have been carried out for the siting and design of Longannet Power Station on the north bank of the River Forth to safeguard against any injurious increase in pollution. Gauges checked by the Warren Springs Laboratory of the Ministry of Technology are sited in the Area (though not part of the current National Survey of Air Pollution), and no abnormally high levels of pollution have been reported. Householders questioned in Grangemouth, however, complained of smells from the nearby oil refinery and housewives in Laurieston confirmed that strong smells were experienced when east winds prevailed.

Although domestic fires are a serious source of pollution, the Designation of Smokeless Zones goes some way towards its control in existing urban areas. Analytical studies by two members of the staff at Warren Springs Laboratory have shown that air pollution may be reduced by choosing sites for new development which allow maximum dispersal by natural ventilation: open windy areas where deep temperature inversions occur are rare. These studies recommend that the most satisfactory location for industry is along the downwind side of the town, separated from it by open space. The width of the open space suggested for a town of 100,000 inhabitants is one mile; this would overcome the "fall-out" of dust and grit settling in residential districts and also avoid sulphur dioxide polluting the town and industrial area itself (if the pollutants enter the atmosphere from high chimneys).

Air pollution from domestic fires can be overcome by district heating. The authors suggest that in a town of 100,000 inhabitants the dwellings might be grouped in ten areas, each containing a three hundred foot high block of flats, with a concealed chimney for a coal or oil fired heating plant serving the block and adjacent dwellings so that high-level emissions can be readily dispersed by natural ventilation. The high blocks must be sufficiently far apart to lessen the risk of pollution from the fire of one block blowing directly into another.

The motor vehicle is another serious and increasing source of pollution, but this may be reduced by selecting roads on open terrain or raised high enough for air flows to provide natural dispersal.

## Micro-Climate

Many aspects of the Growth Area's climate have already been discussed in the "Natural Features" section of this Report. This section is concerned with micro-climate and ways in which people have modified, or failed to modify, their environment to overcome its effects. Individuals respond differently to variations in climate: the most vulnerable groups being young children, the elderly, the disabled and shoppers.

### Micro-Climate in the Growth Area

The main factors contributing to the micro-climate are prevailing winds, rainfall, orientation, altitude and slope; these may combine to produce fierce gusts, driving rain, and frost pockets; or conditions of calm and sun traps. Favourable areas for residential development are likely to be below 400 ft. O.D. because of the combined effects of wind, rainfall and temperature. Existing settlements above 400 ft. O.D. include Shieldhill, California and Wallacetown. At Shieldhill, for example, the long, straight main street is exposed and windy; it runs along a N.S.W.-E.N.E. axis channelling the prevailing wind. The school site and playground at California are similarly exposed. South-facing slopes are generally warmer and may therefore be acceptable for residential or other development above 400 ft. O.D.: some of the farmhouses on the hills west of Denny, and the Infectious Diseases Hospital at Falkirk, take advantage of this condition.

The extensive flat area of the Carronlands is exposed to the full force of the wind which funnels through the gap between the Kilsyth Hills, the Slamannan Plateau and along the Valley of the Bonny Water towards the Forth. Most of the farm buildings here are protected by closely planted groups of trees which create attractive sheltered enclaves.

The north-facing slopes in the Growth Area often enjoy spectacular views of the Forth and the Fife Hills beyond. Much of Bo'ness is built on north-

facing slopes sufficiently steep to preclude the possibility of adequate sunlight entering the living rooms and gardens, and walls and roofs tend to become lichen-covered. Paths or steps on these slopes are often difficult to negotiate in times of frost and snow.

Some shelter is provided in Falkirk's shopping centre by narrow streets and alleys at right angles to the High Street, where it is more important to have sheltered conditions in poor weather than sunlight on good days. The covered ways at Charlotte Dundas also provide welcome protection on rainy days.

Some sites continue to remain vacant because of local knowledge of the adverse micro-climate, and extensive dereliction in the valley of the Bonny Water may be partly attributable to this. Some improvement to the micro-climate in the valley should result from the tree planting recently carried out at the Castlecary roundabout, and additional planting in the vicinity could greatly improve conditions in the valley by reducing the wind force.

Psychological effects of colour should also be considered since colourful stimulating surroundings can be created which mitigate this depressing effect of unfavourable micro-climate.

## Safety

This study deals with the aspects of safety associated with traffic. Professor Buchanan highlighted the present situation when he wrote in "Traffic in Towns":

"To be safe, to feel safe at all times, to have no serious anxiety that husbands, wives or children will be involved in a traffic accident, are surely prerequisites for civilised life. Against this standard, subjective though it may be, the conditions in our towns resulting from the use of motor vehicles obviously have a great deal to be desired."

He showed that in the pedestrian/vehicle conflict, 73% of all casualties occur in urban areas, and 80% of all fatal and serious accidents to pedestrians are connected with the act of crossing roads. Vehicle speed was reckoned to have a large influence on safety and in residential service roads, speeds exceeding 20 mph were incompatible with the needs of pedestrians and the environment generally.

It is widely accepted that a separation of vehicles and pedestrians into different circulation systems is conducive to safety: the application of these principles to residential areas promotes dwellings facing an internal footpath system on one side, with a spur or cul-de-sac road for vehicles on the other. This is the essence of "Radburn" planning. Residential layouts of the Radburn type aim to improve safety and the general amenity by restricting vehicle circulation to peripheral roads whilst permitting vehicular access to dwellings. Internal pedestrian circulation is independent of the road system.

One cause of general dissatisfaction with most bearing on safety is the location of play spaces: since garage forecourts and culs-de-sac have a fascination for small children (observed even by Clarence Stein, the designer of Radburn, U.S.A.). It is of the greatest importance to provide adequate and safe facilities for young children.

### Safety in the Growth Area

The accident rate in wholly residential areas may be statistically too small to draw direct conclusions, but there are many obviously dangerous examples in the Growth Area where urban functions are mixed: houses with doors opening from footpaths of classified roads; "through" traffic in residential areas; shopping areas with frontages to busy roads; factory entrances with poor sight-lines, and so on. During

1964 numbers of licensed vehicles in Stirling County increased by nine per cent compared with the national increase of 8.5%: casualties within the County increased by more than 8.5% over 1963 figures, compared with an increase of 10.1% for Scotland as a whole. The two particularly vulnerable age groups were the under fives and the over sixties.

There are too few examples of pedestrian and vehicular separation and precinct planning to enable their effectiveness for safety to be assessed statistically; however, sufficient is known to justify an extension of the principle.

### Noise

Noise is an increasing nuisance generated largely by motor-vehicles and to a greater or lesser degree by railways, aircraft, spectator sports, construction works, etc. It is difficult to show objectively, however, that noise at the levels normally encountered in towns has any measurable effect on people and it is therefore difficult to justify legislation for noise control, other than to meet the specific requirement of the Noise Abatement Act.

The London Noise Survey (1961) examined levels of noise existing in typical situations, and found that road traffic was the noise most frequently heard, and comparable in annoyance with air pollution. The B.R.S. report "Transport Noise in Towns" describes the survey's typical noise levels (See table below) and states: "obviously noise climates A or B are intolerable to people in most present day types of building exposed to such levels, whereas it is unreasonable to expect to have levels equivalent to rural areas, such as F or G, in a densely packed urban area. There is a difference of at least 20 dBA between these two extremes and to steer some middle course, that is to aim to have a noise climate such as D or no more than 65 dBA for ten per cent of time by day and 55 dBA by night, is indicated. At this level of 65 dBA, however, and with the present kinds of vehicle, the peak noise levels are still potentially 80/90 dBA when a heavy vehicle or motor cycle goes past, so planning must, by direct or indirect methods, ensure that such peak levels do not occur sufficiently frequently to raise the general noise climate."

Subsequent studies by the LCC/GLC scientific branch in 1964 suggest that after about twelve hun-

dred vehicles per hour the noise level is not raised appreciably even if there are more than double that number of vehicles. Traffic containing fifty per cent of heavy vehicles (heavy commercial vehicles, buses, coaches, motor cycles etc.) makes nearly twice as much noise as traffic containing predominantly light vehicles (private cars, taxis, light commercial vans etc.).

The Wilson Report suggests that the solutions lie in reducing the noise of vehicles, the time during which it makes the noise, and the number of vehicles passing a given spot. The third solution holds the greatest promise. New areas will obviously be an easier problem than existing ones. By-passes and ring roads cannot help where large volumes are generated in the larger urban areas. But canalisation of traffic onto main urban networks is an acceptable solution, excluding all but very local traffic from within the cells which would provide areas where the pedestrian would take precedence over the motor vehicle. These special networks would require to be of adequate capacity and would confine noise problems to the buildings immediately adjacent which should be designed or protected accordingly. Adequate methods of sound control are possible, but at present involve excessive costs for residential development. Elevated roads cannot be regarded as an acceptable solution because they allow a greater spread of noise, but embankments and screens of trees are thought to contribute to noise reduction, though data is limited on this aspect.

### Noise in the Growth Area

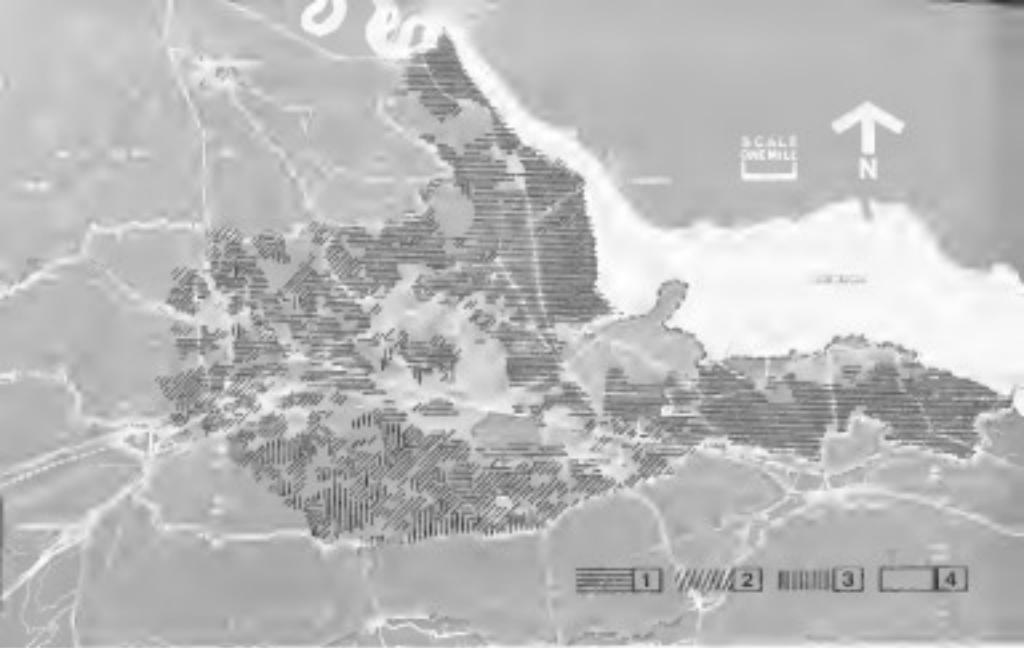
A general assessment of the noise of traffic in the Growth Area indicates that acceptable noise levels are exceeded in several zones. Conditions are worst where dwellings face directly onto the pavements without front gardens, and in the older areas where narrow streets intensify the situation. Many heavily trafficked routes traverse residential areas and volumes of industrial traffic are high, especially in Grangemouth. Industries are also an important noise source in the Growth Area: these are scattered and are often within or adjacent to residential areas. Industries creating most noise nuisance in the Area are foundries, joinery works, railway goods yards, coach builders, and a shipbreaking yard in Bo'ness.

### Groups of Locations where Road Traffic Noise Predominates

		10%-50% Levels (dBA)*	
		Day	Night
A	Arterial roads with many heavy vehicles and buses (kerbside) (4%)**	80-88	70-80
B	1 Major road with heavy traffic and buses 2 Side roads within 15-20 yd. of roads in groups A or B above (B is 12%)	75-83	61-69
C	1 Main residential roads 2 Sideroads within 20-50 yd. of heavy traffic routes 3 Courtyards of blocks of flats, screened from direct view of heavy traffic (C is 17%)	70-80	55-64
D	Residential roads with local traffic only (18%)	65-76	53-65
E	1 Minor roads, gardens of houses with traffic routes 2 More than 100 yd. distant (E is 23%)	60-51	49-43
F	Parks, courtyards, gardens in residential areas well away from traffic routes (9%)	55-60	46-41
G	Places of few local noises and only very distant traffic noise (1%)	50-47	43-40

\* Single figure gives, dBA is used to give what might be called a reasonable engineering relationship with loudness level in phon for most kinds of noise encountered in cities.

\*\* Percentage of measuring points falling within each group.



Map No. 15. Soil Fertility Key 1. A : A, B + soils 2. B soils, 3. B-, C soils 4. D and non-arable soils



Map No. 16. Woodland

## AGRICULTURE

The type of farming found in any area is a result of both physical and economic conditions. The principal physical ones are those of soil and climate, while the economic ones include supply and demand, availability of labour and capital, transport, costs of production and profit margins.

The Growth Area's most extensive land-use is agriculture and is a perfect sample of Patrick Geddes' 'valley cross section', showing a gradual transition from exposed upland of low productivity to rich arable farms near sea level.

### Hill Farms

From the highest point in the Growth Area, Durrock Hill (1150 ft. O.D.) in the west, the land slopes steeply down to seven hundred feet. The soils within this area are clays, and skeletal soils derived from basaltic lavas, with peat on badly drained areas (see Maps 4 "Relief", 11 "Soils", and 15 "Soil Fertility").

The exposure, high rainfall (over inches), and steepness combine to produce thin poor soils within the drainage basins, free and imperfect, to poor and very poor. The vegetation is heather moor, rough grass, gorse and bracken, supporting a hill sheep and stock rearing type of farming.

### Mixed Farms

Between seven and four hundred feet, climate and soils show local improvement in areas of shelter, good drainage, slope and orientation. The soils, derived from boulder clay of carbonaceous sediments, are in the 'C' and 'B minus' type, and carry mixed arable, stock and dairy farms. In the less favoured areas permanent pasture and rough grazing for sheep and cattle is the rule. Rainfall in this zone is between forty and fifty inches per annum.

### Aridic Farms

Below 400 ft. O.D., fertility continues to improve with lower altitudes and gentler slopes, from "B" to "A plus" quality. The "B" soils tend to be found on the sandy and silty raised beaches, the sandy or loamy hills, and the alluvial plains. The "A" soils can be closely identified with the flat land near the sea level, derived from marine silts and clays, and the clayey and partially water-sorted soils with good drainage and aspect. They have an average rainfall of thirty five inches or less, and are mainly devoted to intensive arable and dairying.

## FORESTRY

Woodland shares the distinction with agriculture and the urban areas of being one of the major land uses in the Growth Area, accounting for about 4% of the total area. We are indebted to the Forestry Commission for woodland statistics compiled from the latest Census (1966), and for their comments on them. The distribution of woodland shown on Map 16 "Woodland", is based on an aerial survey of 1960.

The presence or absence of woodland over any area can be attributed to influences of either a positive or negative nature. For example, the positive factors include man's functional needs, like timber production and shelter, and suitable soils and climate. The negative ones, which inhibit or prevent tree growth, include incompatible functions like agricultural and transportation activities, severe winds and toxicity. The various combinations of these factors have resulted in four main types of woodland in the Growth Area. They are natural, ancient, shelter and economic.

## Types of Woodland

### Natural

This type of woodland has the distinction of always being unplanted; it appears and persists where land is not subjected to negative effects like cultivation, severe wind, or erosion. It is found typically on canal, river and railway banks, and on poor, rocky and peaty soils. The composition depends on the climate and soil conditions, varying from mixed deciduous high forest on favoured areas like the banks of the Avon, to dwarf scrub on deprived areas like Letham Moss.

Where land is at a premium for agriculture, as on the Carse and the other fertile soils, natural woodland is restricted to small clumps and narrow belts; while on the poorer soils like the Torwood and Drumwood areas, it has often been superseded by economic forestry. It is retained in some cases for reasons of amenity around estates, or the process of natural regeneration may cause planted areas to revert gradually to the wild state.

### Amenity

This and the succeeding types of woodland were generally planned and planted for specific functions. In this case it was primarily for scenic effect, with a bonus from screening, and the improvement of local climate.

The distribution is closely related to that of the large estates throughout the Area; the most obvious being Dummore, Airth, Kincard, Callendar, Larbert and Pollok Park. Since the siting of estate mansions and their policies was coincident with the past pattern of land ownership and agriculture, this type is spread fairly evenly throughout the more fertile farm lands. Subsequent changes in land use and ownership have resulted in amenity woodland being used for golf-courses, institutions and certain types of residential development. The trees are very often exotic and ornamental, including cypress, sequoia, North American conifers and Spanish chestnut. In some cases amenity woodland has evolved from the natural types, and includes many indigenous species like beech, lime, elm and oak.

### Economic

With economic woodland the primary function is timber production, and being firmly tied to financial returns, that type of land use has to compete with marginal and hill farming in areas of poorer soils and more rigorous climate.

The siting of such woods is based on the "net discounted revenue" which may be expected from them. This is a calculation which assesses the potential productivity of any area, and relates it to the costs of production. The factors involved include the size, shape and cost of the site, access and internal roads, drains, fences, cultivation, plants and planting, the nature of the soil and the climate. The availability of labour, and the marketing of the timber, as well as the side effects of afforestation on the surrounding economy, are also considered.

In the Growth Area all the commercial woodland is privately owned, and is usually managed under a Dedication Scheme. It exists in blocks from about five to over two hundred acres, the largest being at Callendar Park and Dummore, and is nearly all of coniferous species.

### Shelter

The primary function of this type is to improve the local climate for stock, crops and people. It may also serve in boundary demarcation, and has a marked effect on the scenery.

It exists in two forms: the block, which may be

designed to intercept wind from any direction; and the belt, which is usually oriented at right angles to the prevailing wind, and to the slope of the ground. Two further sub-divisions can be made: species and width. Most of the shelter planting in the Growth Area has been of indigenous hard woods in belts from a few feet to over a hundred feet in width. There are indications that this pattern may be changing towards coniferous plantings, from twenty five to seventy five yards and over in width.

Many of the shelterbelts in the Area are over-mature, or completely decayed, as at Loanfoot on the edge of the Stannan Plateau; some very good examples exist at Powfoot and in the Bo'ness area.

### Distribution

The assessment of woodlands in the Growth Area was completed by 30th June 1966 and their area, which included all stands of one acre and over in extent, amounted to 2200 acres. In type and distribution these woodlands, while conforming to the general pattern encountered in central Scotland, have the regional distinction of being determined by the characteristic drainage and ground conditions of the Firth River boulder lands. In the main the woods have been established for amenity and shelter but a number are sited on areas which, if adequately drained, might be converted to agricultural uses.

TABLE 1:  
*Distribution of Acreage by Forest Type*

	Area Acres	% of Total
Coniferous High Forest	800	36
Broadleaved High Forest	900	41
Scrub	360	17
Felled	140	6
Total	2,200	100

In Table 1 figures show that only 77% of the woodland area can be classified as productive high forest. The area of scrub and felled is being progressively extended as mature crops are being harvested. In recent years a considerable acreage has been disafforested to meet the demands of road making, house building and industrial expansion. A number of stands can now be regarded as lost to economic forestry since their purpose is amenity around housing estates, hospitals and recreation parks. The area classified as scrub extends to 360 acres and consists mainly of poor quality birch.

### Distribution by Age Class

The age class distribution of the 1700 acres of High Forest is given in Table 2. This shows that, while the conifers have a reasonable acreage in each age class, the broadleaved are imbalanced for 63% are in the 81-120 age class. The position of the broadleaved trees must deteriorate in the future since very few have been planted during the past twenty years.

TABLE 2:  
*Woodland Structure by Age and Species*

Age Class	Congiferous High Forest	Broadleaved High Forest
	Area Acres	Area Acres
1-10	210	Negligible
11-20	220	Negligible
21-30	75	60
31-40	75	60
41-60	145	35
61-80	35	175
81-120	40	570
Total	800	900

### Distribution by Species

As shown in Table 3 (which does not include species of less than 5% appearance), Scots pine is dominant among the conifers, and occupies 80% of their area. Sitka spruce and European larch are the only other species in this group of any significance. While the broadleaved stands rarely consist of one species alone, their areas have been aggregated in Table 3 according to their proportions in mixture. Sycamore is the most important species followed by oak, beech and elm in nearly equal distribution.

TABLE 3:  
*Woodland Structure by Species*

Species	Area Acres
Scots pine	640
Sitka spruce	100
European larch	60
Total	800
Sycamore	400
Oak	200
Beech	150
Elm	150
Total	900

### RESIDENTIAL

The Planning Research Unit, Edinburgh University, examined the physical aspects of residential distribution throughout the main urban areas using the 1961 Census, Local Authority Development Plans, information on Improvement Grants and Standard Grants, aerial photographs and observations. This data was used to determine the location, character and intensity of development.

The Department of Social and Economic Research at Glasgow University carried out a sample survey of households by interview to obtain information on tenure, rent structure and deficiencies in type, amenities and quantity. In connection with this, the Planning Research Unit with assistance from the Local Authorities carried out a further complementary survey of the same sample which included age, anticipated life and environmental assessment. This information provided the basis for a study of the quality of residential environment and was also correlated with the household survey, fully described in Volume One, Chapter 7 of this Report.

### Location and Character of Residential Areas

In 1961 the total population of the Growth Area was 124,167: an increase of five per cent over the 1951 census figure. Falkirk had the largest population (thirty per cent of the total for the Growth Area) with Grangemouth showing the greatest absolute increase and rate of growth. The four Burghs, Falkirk, Grangemouth, Denny-Dunipace and Bo'ness, accounted for sixty per cent of the total.

The first study undertaken by the Planning Research Unit deals with location, character and densities, and is confined to the main urban areas of Falkirk; Grangemouth; Bo'ness; Denny and Dunipace; part Eastern District No. 1 (Lambert, Scanhousemuir, Carronshore); part Eastern District No. 2 (Laurieston, Redding, Westquarter, Polmont, Brightons). Information was grouped by Enumeration Districts (excluding special E.D.'s).

Significant totals for population and land uses are as follows:

Population within urban areas	100,900 persons
Residential areas (net—1961 Census)	2,770 acres
Areas built since 1961	255 acres
Areas demolished since 1961	17 acres
Areas redeveloped since 1961	18 acres
Areas committed by L.A.s for future residential development (including ancillary functions: school sites and open space)	1,035 acres

The majority of dwellings in the Growth Area were built since the turn of the century, and these have amalgamated into scattered groups rather than as continuous growth associated with one main centre such as Falkirk. Grangemouth is however one exception to this rule: developing rapidly during recent years within a very restricted area, almost surrounded by industries.

By far the largest proportion of housing in all areas has been built by Local Authorities, but some has also been built by agencies for their employees: pre N.C.B. mining companies, the Forestry Commission, etc. Most housing in the public sector was built after 1919, and generally consists of semi-detached houses and flats dwellings. A substantial amount of housing in the private sector was built during the period 1881-1900, mostly of flats dwellings.

Some post war "middle income" housing has been built but no discernible pattern emerges. The largest concentrations are found in Falkirk (High Station area); Polmont (Polmontbank and Millfield); Laurieston (Muirville); Grangemouth (Primrose Avenue and Bo'ness Road area); Stenhousemuir (Stenhouse Castle). Substantial areas of middle-income housing are being developed or proposed at Denny (Burgh extension area) and Bo'ness (Kinnel).

Stone is the traditional building material, but

newer dwellings see mostly rendered, with occasional timber cladding and brick being used. One and two storey dwellings predominate, in formal road-lined layouts. By present day standards pre-war housing designs are poor, both visually and functionally, and post-war development has mainly shown improvement in the latter aspect only. However, many amorphous housing areas where gardens have been carefully tended and planting is mature, seem much more attractive and less bleak (e.g. "cul-de-sac" layouts in Westquarter and Larbert.)

In the older residential areas infilling is rarely sympathetic, either in scale or choice of materials. Magnificent views towards the hills and across the Forth are seldom exploited. Many areas suffer from traffic nuisance and the effects of adjoining industries. Extreme cases occur at Bonnybridge and Denny where new monoway standard roads pass nearby.

In a few recent housing schemes a high standard of design and layout has been achieved: a high degree of pedestrian separation and many amenities provided such as playspaces, garage courts, sheltered seating areas, etc. The most notable are the Local Authority development at Grangemouth (Charlone Dundas) and the private development at Polmont (Polmontbank). Schemes now in progress are tending towards higher dwelling blocks: Falkirk—Callendar Park (fifteen storeys); Grangemouth (five storeys) and Bo'ness-Grangepans (five storeys) where building heights are limited by poor bearing capacity of the land and past mining activities.

Since the majority of dwellings have been built by Local Authorities, mainly since the First World War, there are relatively few technically unfit houses considering the extent of residential areas of the older houses, built between 1881-1918; many are privately owned, and will present further difficulties to redevelopment. The Housing Survey by Glasgow University shows the full extent of present deficiencies; the majority of householders living in dwellings lacking some amenities, expressed unwillingness to



Photo 10: Miners' Rows, Bo'ness



Photo 11: Traditional terraces, Fairview



Photo 12: Inter-war housing, Stanhousemuir



Photo 13: Charlotte Dundas development, Grangemouth



Photo 14: Palmontbank development, Polmont

pay more for them; the most important single reason for households wanting to move, was that the present dwelling was too small; there were more households trying to move from dwellings built since 1945, than from dwellings built between 1881-1900, but the restricted size was of more significance in the latter group.

### Residential Densities

This study assesses the existing range of net residential densities throughout the urban areas, to help formulate density policies for new residential development and to give information on the effects of existing and possible future redevelopment proposals in later studies. The population living in the main urban areas studied is over 80% of the total population. The range of densities varies widely from 13 p.p.a. in the Laurieston/Brightons area to 131 p.p.a. in Williamson Street, Falkirk, giving an average overall net density of 36 p.p.a. Details are given in Table 1 below:

The analytical study of residential densities revealed Falkirk as having the largest areas of high density; Grangemouth, with a more even distribution, but the highest average density; and Laurieston/Brightons area with the lowest average density.

### Assessment of the Residential Environment

The foregoing analytical studies of residential areas undertaken by the Planning Research Unit confirmed the belief that age and condition of dwellings is only a minor contributory factor influencing the quality of the residential environment. To make a comprehensive survey of residential environment, a check list of basic requirements was prepared, and subsequently used as the criteria for comparative

analysis of the main residential zones in the Growth Area. These criteria are listed below under the general heading: Principles.

### Principles

The residential zone should be safe for children and pedestrians; provide adequate space for parked vehicles other than on the highway; not be unduly affected by atmospheric pollution or excessive noise from vehicles or incompatible land uses; provide adequate space about buildings (private gardens, playgrounds or public open space); be pleasant in character; and provide an acceptable outlook from livingrooms; have a satisfactory micro-climate; be adequately served by social facilities.

An assessment of the extent to which the above principles are met in existing residential zones was made by examining the following inter-related factors: type of road serving the dwellings; form of layout; parking or garaging provision; surrounding land use and landscape; open space; visual quality; provision of social facilities (the latter being fully studied in subsequent sections and in Volume One, Chapter 8).

### Method of Analytical Studies

The assessment of residential environment was carried out by investigating each dwelling in relation to all the principles outlined above which are optimum standards implicit in any new housing scheme. In existing residential areas the optimum is not always feasible and minimum acceptable standards must therefore be set. The minimum acceptable standard adopted in this study should ensure an environment where it is safe and healthy to live, and to bring up children. It has been classified as the datum rating: indicating a layout in which traffic is

TABLE 1: *Densities (Net) 1961*

Urban Area	Average Density p.p.a.	Range of Densities	Main Areas of Lower Density (under 35 p.p.a.)	Main Areas of Higher Density (over 60 p.p.a.)
		Min.	Max.	
Laurieston/ Brightons	28.5	13	41.5	Brightons, Laurieston, Redding
Bo'ness	35	16	99.5	Areas south and east of Gilmerton Park
Larbert/ Stenhousemuir	34	17	60	Main Street area and to the north
Denny and Denipace	37	20	51	Seirring Street, Glasgow Road, Broad Street and south of railway line
Falkirk	40	18	131	Woodlands and Arnethill area
Grangemouth	42	17	77	North-east of Zealand Park
				Old dock area, Rennie Place, Newlands

light and residential in character; where a private open space or garden is available; where some garaging or off-street parking spaces are provided; and where the surroundings are to some degree enhanced by planting, open space or views.

Three ratings were originally evolved: the datum (Fair Plus = C) and two extremes of environmental quality (Poor = A and Very Good = E). However, two intermediate ratings were also found to be necessary (Fair = B and Good = D), because of the wide variations in existing urban areas. Two further categories (Rural and Insulated) were subsequently included to cover dwellings in rural settings where adverse environmental factors occur less frequently; or in an urban setting situated in extensive grounds with driveway access from the street. Both would almost certainly have adequate environments. All other ratings refer to groups of dwellings or layouts. The following are examples of the main ratings:

A = Dock area, Bo'ness

B = Glasgow Road, Denny

C = Livingston Drive, Castle Loan, Bo'ness

D = Rosehill Terrace, Falkirk

E = Charlotte Dundas housing scheme, Grangemouth.

The wide variation between areas satisfying and not satisfying the basic requirements is illustrated by Table 2 "Housing Survey: Assessment of Environment" which identifies five main classes of residential environment found within the Growth Area.

#### *Application*

This assessment was carried out in all of the main urban areas: Falkirk, Grangemouth, Bo'ness, Denny and Dunipace, Bonnybridge, Larbert/Stenhousemuir/Carron and Carronshore, Laurieston/West-

quarter / Redding Redding Muirhead Brightons Polmont Station Old Polmont.

The rating applied to the individual dwellings listed in the Housing Survey by inspection on site, and areas of residential environment of similar rating were defined by observation and by the "steering" of other relevant factors. These included the existing pattern of main traffic routes and trunk roads, open spaces (public and private), industry and noxious land uses. The results were then summarised both for individual urban areas, and for the Growth Area as a whole. Grangemouth has been taken as an example of the latter to show application of the ratings in detail (see also Map 17 "Grangemouth"). The other urban areas are described in Appendix 2.

#### *GRANGEMOUTH*

The oldest part of Grangemouth by the Canal Basin is nearly all demolished. The remaining dwellings were rated Poor because of layout and advancing obsolescence. Part of the Central Area around Lumber Street consisting of obsolete property was rated Poor. Much of this area has been designated as a CDA.

Areas south of the CDA were rated Fair but these could be temporarily improved by making some streets into culs-de-sac by the reorganisation of traffic circulation. This area might be redeveloped to provide additional central facilities. Areas adjacent to most main traffic routes were rated Fair. Volumes of industrial traffic (especially tankers) going through the Burgh are markedly high. Many lorries from the refinery use Kings Road as a short-cut, passing very close to the houses which have no gardens. Abbots Road suffers in this way and part was rated Poor although properties are substantial. Also rated Fair were areas in close proximity to the main industrial concentrations. Industry has many effects throughout Grangemouth, particularly as a result of traffic, smell and smoke, but these could not be assessed precisely except in the worst and obvious cases.

TABLE 2: *Assessment of Residential Environment*

Environmental Rating	Road Use	Layout	Parking	Outlook/ Surroundings	Open Space	Visual Quality
Class A	Main traffic route	Housing frontage on pavement and/or inadequate space about buildings.	Kerb-side parking only.	Absence of planting and/or with outlook to noxious land uses.	No garden or only drying green, and no access to open space.	Jarring use of materials, or unsympathetic or dull design or layout.
<i>Class B (between "A" and "C")</i>						
Class C	Occasional or light traffic route.	Separation from road by front garden.	Some garages and/or off-street parking.	Some trees or planting. Outlook to compatible land uses.	Garden, or access to communal garden, open space or children's playground	Sympathetic use of materials or inoffensive in character.
<i>Class D (between "C" and "E")</i>						
Class E	Residents only service road, or cul-de-sac.	Pedestrian separation.	Approx. 1:1 garaging and/or off-street parking.	Good surrounding landscape. Pleasant approach and outlook.	Private or communal garden, plus play area or park.	Unified design and layout.

The housing survey, being a sample of all dwellings in the Area, included a number of properties which could not be covered by the above five categories. These properties were classified as follows:

F: Rural (e.g. farm workers' cottages, isolated crofts, etc.)

G: Dwellings in large grounds (i.e. over one-third of an acre)

H: No information available



Map No. 17: Assessment of Residential Environment—Grangemouth

Key: 1. Class A. 2. Class B. 3. Class C. 4. Class D. 5. Class E. 6. Class F.

Most of Grangemouth housing areas were rated Fair Plus, but some improvements were desirable, such as planting and the reorganisation of traffic circulation. Many of these areas are not conveniently related to the town centre. The Glensburgh area was also rated as having an adequate residential environment, but it is bounded on two sides by busy traffic routes, is adjacent to heavy industries, and is in a rather isolated position. For these reasons it might not be a suitable area to redevelop for housing when existing properties become obsolete.

An encouraging number of areas were of sufficiently high quality to be rated Good, either because a satisfactory degree of pedestrian segregation has been achieved (e.g. Craigleath Road), or because minimal traffic volumes are combined with pleasant outlook (e.g. Abbotengrange Road, opposite Zetland Park).

The new Charlotte Dundas scheme was rated Very Good. It is an excellent example of this category, with an interesting network of pedestrian ways linking the shopping precinct, school, play spaces and garage courtyards, achieving a high standard of design and layout.

#### *Sub-regional assessment*

This overall assessment indicates that the vast majority of dwellings will become obsolete within the next twenty years unless remedial action is taken to correct the deficiencies inherent in the residential areas throughout the Growth Area. The distribution of the five main classes of environmental rating is discussed below:

A (Poor): Residential areas falling into this class were found throughout the Growth Area. They were usually associated with the oldest housing where space standards are low (Bo'ness and Denby), and often aggravated by heavy traffic and the presence

of noxious industries (parts of Larbert/Stenhousemuir and Grahaston). Falkirk contained the most areas in this class (which also included areas already designated as C.D.A.s or C.A.s). Laurieston/Brightons area had least.

B (Fair): A substantial number of residential areas fell into this class, particularly where housing had frontages to heavy traffic routes and was adjacent to heavy industries (Hayfield, Falkirk). Other adverse influences included high tension overhead electricity cables, with their pylons in back gardens and open spaces (Ladeside Crescent, Stenhousemuir).

C (Fair Plus): By far the largest proportion of residential areas were in this class. Although accepted as adequate, improvement of many areas is desirable: post-war L.A. housing estates, for example, tend to be bleak and could be readily raised to a higher class by tree planting, the provision of better parking facilities and play spaces.

D (Good): A number of small residential areas were found where culs-de-sac gave protection from motor vehicle intrusion or where layouts were particularly spacious and well planted, with adequate parking provision, etc. (Rosehill Terrace, Falkirk, and Old Polmont). Grangemouth had the most areas in this class.

E (Very Good): The only two residential areas with high standards of pedestrian/vehicular separation, and overall consistency in design of buildings and layout were the Polmontbank development, Polmont, and the Charlotte Dundas development, Grangemouth.

No residential areas were found which could be rated either "Good" or "Very Good" in the following areas: Carronshore, Redding, Redding Muirhead, Brightons, Larbert, Bonnybridge, Denby and Dunipace and Polmont Station.



Photo 15: 'A' Class environment, Bo'ness



Photo 16: 'B' Class environment, Stenhousemuir



Photo 17: Caffender Riggs shopping centre, Farnham



Photo 18: Shops at Leamington



Photo 19: Charlotte Dundas shopping centre, Grangemouth

## SOCIAL FACILITIES

### Shopping

The study of shopping areas was undertaken jointly by the two Universities. The study included: location, type, shopping floor space and number of floors, condition, access, assessed rental and whether less than five years old. Data for the analytical study was extracted from field surveys, Valuation Rolls and Development Plans. Results have been summarised in Volume One, Chapter 5, which includes details of deficiencies in distribution and quality and absence of variety or competition. The location of these main shopping areas has already been covered in this Volume: Chapter on Settlements. This Chapter is mainly concerned with the character of shopping areas, their size and type, and committed plans for their renewal.

### Character

Few of the older centres have any charm or architectural character. One exception is the narrow High Street in Falkirk which has an extremely pleasant scale, with subtle changes in direction and spatial relationships. The existing centre at Bo'ness must originally have had great charm: the main street crooked and narrow with robust architectural style. The buildings have now deteriorated and the area is ripe for development; with the growth of the Burgh to the south and east, the centre is inconveniently located for the majority of residents and a new shopping centre is already proposed that will overcome this difficulty.

Most shopping areas lie on both sides of traffic routes and have few parking facilities. Large volumes of "through" traffic traverse the shopping centres at Falkirk, Laurieston, Old Polmont and part of Larbert, and most other centres are on intra-regional traffic routes. There are two completely traffic-free shopping precincts in the Growth Area: the larger is

Charlotte Dundas in Grangemouth where shops form three sides of a pedestrian square with covered walkways. The other, the Callendar Riggs shopping development, Falkirk, is more ambitious: having a traffic-free precinct of two-storeys along one side and a central hotel, with pedestrian access at first floor level both from the High Street and across a busy road from the bus station. Both these developments have special service access and a number of public parking spaces available. Except in the High Street, Falkirk, most of the shops in the Growth Area are converted houses which lack the necessary facilities of satisfactory service access, parking and pedestrian separation.

In some districts there is only a single shop, usually a co-operative, but travelling shops serve most of the areas with inadequate facilities, and in Dunmore this is the only alternative to a shopping trip of several miles. Shopping areas in some of the outlying villages on high ground are very exposed and windswept and, as in most other areas, little protection is provided, and only a few facilities offered for the convenience of shoppers. Shops generally are distributed rather haphazardly throughout the urban areas presenting a low intensity of development even where grouped.

In the larger centres, particularly in Falkirk and Grangemouth, shopping is not an exclusive activity, but has also attracted and, in turn, been supported by civic buildings, facilities for entertainment and service industries. The distribution of associated social facilities generally has been covered in Volume One, Chapters 8 and 9.

### Size

Shopping and central area rates within the Growth Area cover some two hundred and fifty acres. Falkirk's centre is the largest with over a hundred acres. A general classification according to size and physical character of centres is as follows:

Large compact centre with a regional catchment:

Falkirk

Smaller compact centre:

Grangemouth (Lumley Street)  
Grangemouth (Charlotte Dundas)  
Bo'ness  
Denny  
Stenhousemuir

Dispensed or linear centre:

Falkirk (Cannongate)  
Falkirk (Grahamston/Mungo)  
Banffshire  
Larbert

Small sub-centre or single shop:

Lauriston	Airth
Brighton	Schiffalls
Ojd Polmont	High Bonnybridge
Polmont Station	Carronshore
Redding	Westquarter
Glen Village	Muirhouses
Calderwood	Redding Muinchard
Shieldhill	Longcroft
Banknock	Falkerton
Haggis	Stanzywood
Dunlophead	

Settlement without shops:

Dunmore Village

In addition to these centres, there are many "corner" type shops scattered throughout the residential areas.

#### *Central Area Renewal*

Throughout the Growth Area urban renewal, particularly of shopping centres, is developing considerable impetus. Many areas are already designated as C.D.A.s or C.A.s, and the Local Authorities are committed to new shopping development in the following existing central areas: Grangemouth, Denny, Lauriston, Stenhousemuir and Falkirk (Garrison Area); a new centre is also well advanced in the design stage for Bo'ness.

#### *Health*

The functioning and administration of Hospitals and Health and Welfare Services are fully described in Chapter 8, Volume One (*The Social Services*). The physical planners have theretofore confined their study to an examination of the Hospital Services: the major land user.

TABLE 1:  
*Hospitals: Location, Size of Site and Building Coverage*

Location	Site Area (acres)	Area covered by buildings (sq.m.)
Falkirk Royal Infirmary ..	22.5	12,000
Falkirk Infectious Diseases Hospital ..	13.0	4,000
Wester Hospital, Falkirk ..	4.0	2,000
Denny and Dunipace Hospital (to be closed shortly) ..	1.0	0.5
Belahdyke Hospital, Larbert (mental illness) ..	127.0	25,000
Royal Scottish National Hospital, Larbert (mental deficiency—two sites) ..	156.0	36,000
Bo'ness Hospital ..	3.0	1,000
<b>Total ..</b>	<b>526.5</b>	<b>78,500</b>

These figures demonstrate that any deficiency existing in the service is more likely to be related to shortages of personnel and capital investment than to shortage of land. The sites do not appear to be so heavily built-up as to preclude the possibility of adding further buildings should more beds of specialist services be required to serve an increase of population or to make good any existing deficiency.

The hospitals at Larbert are situated outside the built-up area in well-wooded grounds, and provide a mental health centre for a much wider catchment than the Growth Area. This concentration was proposed in the Mearns Plan for Central Scotland and the areas described as an extensive health zone. All the hospitals in Falkirk are situated in the southern half of the town, the Royal Infirmary being closest to the centre. Reasonable privacy and a pleasant outlook from the wards is provided at Larbert and the Royal Infirmary Falkirk, and most hospitals are readily accessible by road and public transport.

Medical opinion now tends to look for a reduction in scale of treatment units for mental illness and a corresponding increase in range of treatment offered by one hospital complex. There may be some changes of this type in the future pattern of hospital service in the Area, leading to diversification rather than to alterations in overall acreage.

#### *Education*

The Growth Area is not self-contained for purposes of education, since it forms part of two administrative areas: the Counties of Stirlingshire and West Lothian. Land requirements for education tend to be greater in large urban concentrations because of the wider range of secondary and further education opportunities which can be supported. Thus, considering the present facilities, further increase in the population may lead to a wider choice within the Growth Area, and reduce the need for travel to further educational centres in Edinburgh and Glasgow.

Information on the existing educational facilities has been supplied by Directors of Education for the two Counties. The following summary of statistics has been collated for the Growth Area for the year 1965:

Senior Secondary Schools ..	6,954 pupils
Primary Schools ..	14,825 pupils
Total acreages of school sites ..	245 acres
Official capacity of all schools ..	23,475 places
Total of all pupils on school roll ..	21,779 pupils
Primary school places to be abandoned ..	1,196 places

The capacity of many school classes is based on forty-five pupils as in most cases this is the official maximum permitted size. In practice, a lower figure is desirable and much of the apparent spare capacity is therefore illusory.

Site areas recommended by the School Premises (Standards and General Requirements) (Scotland) Regulations, 1959 are as follows:

Type of School	Site Area
One-stream primary school (seven classes, plus one, for backward pupils) ..	2.75 acres
Two-stream primary school (fourteen classes, plus two, for backward pupils) ..	4.50 acres
Senior Secondary for 500 pupils ..	8.00 acres
Senior Secondary for 1,000 pupils ..	14.00 acres
Nursery school for up to 40 pupils ..	0.25 acres
Nursery school for up to 80 pupils ..	0.50 acres

The provision of Roman Catholic schools depends upon the requirements of the local population. Present needs of the R.C. element of the Growth Area's population are given in greater detail in Volume One, Chapter 8.

The educational facilities for the Growth Area divide naturally into five groups centred on Secondary Schools at Bo'ness, Falkirk, Grangemouth, Denny and Larbert, which are "fed" from the Primary Schools in the associated surrounding area. R.C. Senior Secondary Schools are located only at Stirling and at Bathgate, both being outside the Growth Area. A detailed list giving locations, school rolls, official capacity, site areas and comments on future development for each urban group appears in Appendix 3 of this Volume. This shows that even in Grangemouth which appears to have most spare capacity, as elsewhere this spare capacity occurs on very restricted school sites, or in schools which are in need of modernisation.

From the distribution point of view, the least well-served areas are at the east of Falkirk, near the High Station area, at North Broomage and the eastern part of Larbert, and at Banknock. In these areas children may have substantially further to walk than the three-eighths of a mile considered feasible. If this distance is greater, children tend to travel by public transport, or private car. The new Grangemouth and Bo'ness schools are intended to cater for the incoming population, rather than for improvement of existing standards.

Further education is concentrated at the Falkirk Technical College which has courses in a wide variety of subjects. There is also a teachers' training college at Callendar Estate, Falkirk. Day release classes are also available at Bathgate Technical College for the West Lothian area. Many evening classes are held at Falkirk, Grangemouth, Larbert, Denny and Bo'ness. There is one Education Authority nursery school at Falkirk. Special schooling is available for mentally and physically handicapped pupils at Dawson Park School in Falkirk and there are occupational centres at Torness and South Alva. Some children travel to private schools in Stirling, Bridge-of-Allan, Dollar, Edinburgh and Glasgow, as there are no private schools in the Area.

Schools which the Local Authorities are already committed to abandoning include:

Grangemouth: Zeitland P.S.  
Falkirk area: Launceton P.S.  
Polmont P.S.

Denny and Dunipace area:

Dunipace P.S.  
Broomhill P.S. at } (possibly)  
High Bonnybridge

Larbert: Larbert Village P.S.

New schools already under consideration in the Local Authorities' plans include:

- 1 S.S. at Polmont/Brightons
- 1 S.S. at Bowhouse, Grangemouth
- 1 S.S. at Bo'ness
- 2 F.S.s at Bowhouse, Grangemouth
- 1 P.S. at S. Broomage, Larbert
- 2 P.S.s at Bo'ness

## INDUSTRY

Whatever the approach to the Growth Area, whether by water, rail, air or road, it is dramatically obvious that industry is a major land use, much of it concentrated in extensive zones. Cooling towers and safety fences of the chemical works at Grangemouth; brick works at Greenhill or at Castlecary; the dark chimneys of the Carron Iron Works at Falkirk; the foundry chimneys at Larbert and Denny; timber stacks at Grangemouth and Bo'ness and the many bings and tips tell their own story of the evolution from manufacturing, based on local extractive industries, to that based on imported raw materials. The industrial characteristics of the Growth Area

have been fully documented in Volume 1, Chapter 4, of this Report. The physical planning aspects covered by this section concentrate mainly on matters of direct significance to land use and environment.

### Location and Character

The products manufactured in the Growth Area range from plastics to firebrick, from starch to castings. Food, drink and textiles are comparatively rare. The extractive industries (particularly coal and ironstone mining) on which the Area's prosperity was founded in the nineteenth century, have declined until only one substantial colliery remains. Fireclay continues to be made at Bonnybridge and Torwood.

Although the industries are generally dispersed, extensive areas are taken up by the oil refinery and chemical producing factories on the land near the mouth of the Carron at Grangemouth. There are further concentrations of industry on the banks of the Forth and Clyde Canal, although only limited interest in the Canal is expressed by firms today. Some industrial dereliction occurs in these areas. Although most of the Forth foreshore area at Bo'ness has fallen into disuse, approximately two hundred acres was found to be zoned for industrial use. The scattering of industries throughout the built-up areas creates a serious planning problem. Few of the industries in residential areas are suitable for such locations: noise, smell, smoke, dust and traffic all cause problems and inconvenience. Residential expansion has now engulfed some of the sites on the fringe of the old settlements and old prints show the Carron Iron Works belching smoke in open country; it is today surrounded by housing and other urban uses.

### Employment Densities

In the main industrial areas, the employees per acre are approximately as follows: Falkirk—sixteen; Grangemouth—five; Bo'ness—twenty-five; and Bonnybridge—thirteen. These figures reflect the presence of older firms in Bo'ness and Falkirk, the fireclay firms at Bonnybridge and the chemical works at Grangemouth, and show that densities are generally low.

Intensity of development varies widely. The firms making fireclay products cover an area nearly as great as the metal manufacturers, although employing only about 4% of the labour force as against the metal manufacturers' 17%. The sand and gravel extracted supplies a very active construction industry which employs some 10% of the working population. The 12% employed in the chemical industry operate on very extensive sites, with an average number of employees per acre of five; in metal manufacturing it is thirty. Participation rates for women are low.

### Environmental Factors

Study of atmospheric pollution within the Growth Area (Special Aspects of the Environment) was inconclusive as there is little information on the extent to which dust, smell and noise are more than merely irritants. The study did indicate, however, that no settlement containing industry was entirely free of unpleasant environmental features, and that few people worked in wholly satisfactory surroundings, or in conditions comparable with those in the New Towns. The study also confirmed that special care is needed in layout, design and landscaping industrial sites, and that no offensive industry should be incorporated into residential areas.

No area can properly function without its complement of service industries: plumbers, jobbing builders, electrical repair shops, upholsterers, etc.



Photo 20. Grangemouth Docks (copyright "The Scotsman")

These frequently have great difficulty in maintaining more than basic facilities, and are thus often criticised for their untidy appearance. It is therefore very encouraging that Grangemouth is tackling this problem by erecting small groups of well-designed premises for service industries.

Traffic is also a serious problem: one industry in Grangemouth generates six hundred oil tanker trips a day, and all the routes used by these tankers have some residential frontages. Fortunately the industrial sites there have better car parking facilities than elsewhere in the Growth Area.

## MINING AND SUBSIDENCE

The outstanding minerals of economic value mined in the Growth Area are coal and fireclay; both underlying a large proportion of the total area at various levels, from near the surface to over three thousand feet deep. Other minerals including ironstone and limestone were once worked, but are now no longer of importance. The coal is found in the Limestone and Productive Coal Measures, and the fireclay in the Millstone Grit Series (see Map 9 "Solid Geology" and Diagram II "Geological Section"). Surface minerals like sand and gravel are dealt with in the Chapter "Geology".

### Coal

The history of mining can be divided into three periods: early workings near the surface; deeper workings, using the "long-wall" method of extraction; and modern subsidence mining at greater depths.

The earliest known mining dates back to 1165, when records show that the monks of Holyrood were granted rights to extract coal at Carriden. By 1600, coal from Airmaght and Bonhard was used for

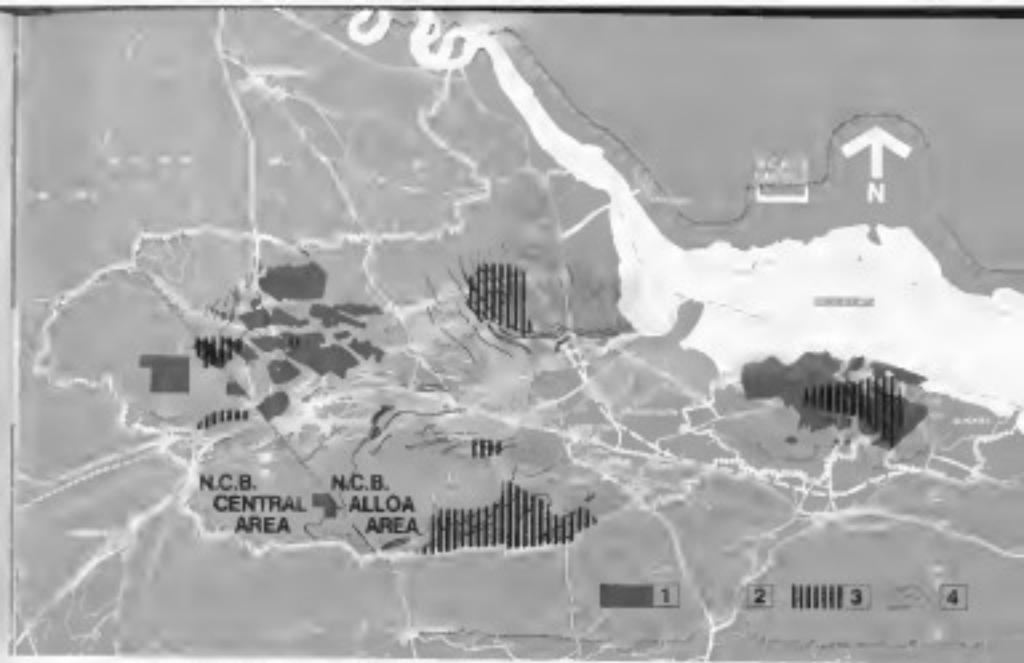
domestic heating and commercial salting, and was also exported.

The first method of mining was by tunnels or "day-levels" dug into the hillsides. Later mines were on flatter ground, in coal seams which outcropped on the surface, or which were covered with a relatively shallow overburden; they were generally within twenty to one hundred feet of the surface. A stoop-and-room method of extraction was used, in which a succession of cavities was dug out, either one at the foot of a shaft, or a series connected by short tunnels, and supported by pillars and arches of natural coal and stone.

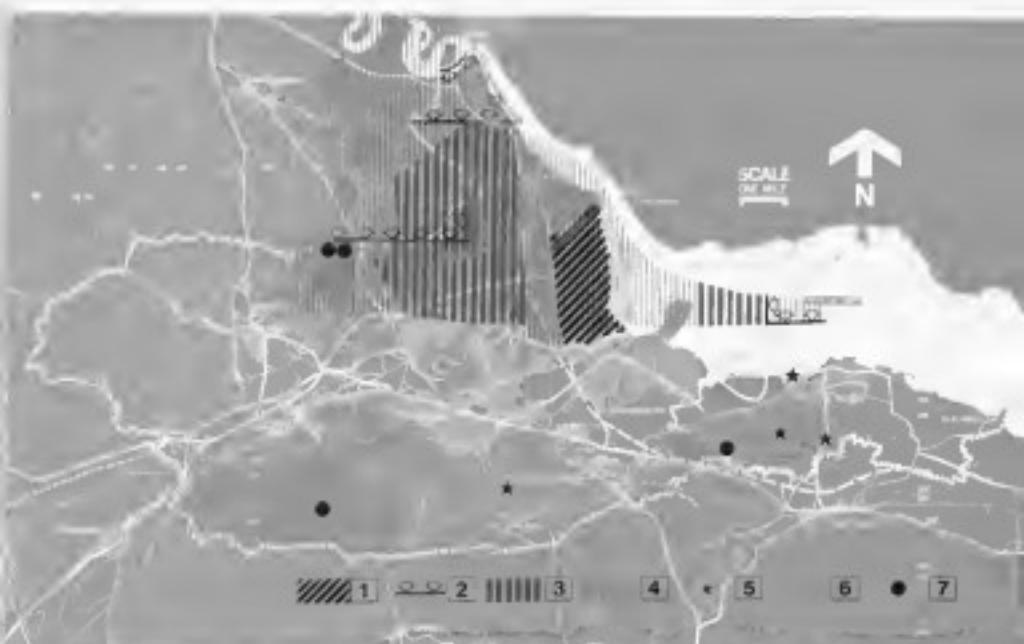
In 1760 the Carron Iron Company, one of the pioneers of the Industrial Revolution, installed the recently invented blast furnace, and accelerated the extraction and consumption of coal, ironstone and limestone. Within ten years the nearby known outcrops of good coal were exhausted, and lower deposits were investigated. Much deeper vertical shafts were needed, but the problem of flooding restricted development.

These early shallow workings, on which little accurate information is available, can all be closely identified with areas where the coal outcrops near the surface. They include Bo'ness, Banknock, Denny, Stenhousemuir, Carronshore, and south of Falkirk (see Map 18 "Mining (Past) and Outcrop", hatched area).

From 1833 to 1840 the mining industry was revolutionised by the improvement of the steam engine, and pumping methods which allowed working at previously inaccessible depths. This did not mean, however, the end of shallow workings, some of which were abandoned only recently e.g., the Mil seam at Tamfourhill (1920-1960), and others still in operation today, e.g. at Airmaght. The long wall method of extraction was also developed, in which no supports remain after extensive areas of coal



Map No. 18. Mining (Past) and Outcrops  
 Key. 1. Limestone coal; 2. Productive coal; 3. Old shallow workings; 4. Coal outcrops



Map No. 19. Mining (Present and Future). Key. 1. Concession area. 2. 1962-1982. 3. 1982-2032. 4. Past 1990.  
 5. Coal Miner. 6. Freeley Rights. 7. Freeley Moat.

seam have been removed; thus allowing the ground to gradually subside. Complete records are not available for this period, since it was not until 1850 that the recording of mine workings became compulsory under the Mining Abandonment Plans Act. The Map 18 "Mining (Past) and Outcrops", which shows the extent of recorded workings is based on information supplied by the Alloa and Central Areas of the N.C.B.

Modern mining, with automatic coal cutters, conveyor belts and hydraulic mobile roof supports, uses a strip method of extraction, in which roof support is withdrawn immediately after the coal seam has been removed. By working deep deposits in long rectangular areas under calculated and controlled conditions and rates of extraction, subsidence can be restricted to predictable limits, producing only a temporary tilt on the surface. Such a method will be used in the workings of the Limestone Coal Group which the N.C.B. propose to develop. See Map 19 "Mining, Present and Future".

### Fireclay

There is a long tradition of fireclay working in the Growth Area. The seams at present being worked are the refractory fireclays of the Millstone Grit Series. The extent of the Millstone Grit deposits is shown in the Map 9 "Solid Geology", while the areas under which there are rights to extract fireclay are shown on the Map 19 "Mining, Present and Future". These are round Bonnybridge, Torwood and near Polmont. The stoop-and-room method of extraction is generally used, in which only one-third of the total area is undermined. In this way support is not withdrawn from the surface, but it is possible, however, that subsidence may ultimately take place, as the old workings disintegrate under the action of water and gravity.

### Subsidence

The amount of subsidence of an area after the coal has been removed depends on the following factors: the depth and extent of the workings and the method of extraction; the thickness and number of seams removed; the percentage, pattern and speed of extraction; the possible backfilling of workings with spoil; the angle of dip (particularly in shallow workings); the nature and properties of the overburden above the workings, e.g. faults, cleavages, tensile strength, etc.; the hydrological system; the age of the workings; and the weight and distribution of subsequent surface development.

The early stoop-and-room workings, which were all shallow and accessible by either day levels or pits, have in many cases not collapsed because of the strength of the supporting pillars, the relative smallness of the cavities, and the comparatively light pressures of the overburden. The entrances associated with these workings may have filled in, may have been plugged at the surface, or may still be open. Since there are no complete records of these activities, and few reliable ones, any area with coal outcrops near the surface is suspect from a safety point of view. The N.C.B. recommend that no surface development should be undertaken on the dip side of outcrops until site investigations have been carried out. These will determine whether or not the area has been undermined, and if so, the condition of the workings, and the nature of the overlying rock and overburden. Map 18 "Mining (Past) and Outcrops" shows the positions, and conjectural locations of outcrops in the Area. The N.C.B. has indicated that there are unrecorded shallow workings in the outcrops of the Limestone coals in the western part of the Area between Denny and

Stirling; at Banknock and in the vicinity of Bo'ness; and in the Productive coals near Carronshore and Falkirk.

This section concerns past mining operations, in areas where exact locations of the workings are known. They are those in the Productive and Limestone Coal groups for which Mining Abandonment Plans or extract records are available, and do not include the earlier workings dealt with in the preceding section. In general it is expected by the N.C.B. and confirmed by the Mineral Valuer that after an interval of several years, the ground above abandoned workings at depth should have settled, and that no further subsidence is likely. Trial boring in the most extensively worked parts of the Productive Measures near Carronshore have shown that the old workings are now well consolidated, are hydrostatically supported, and will not affect the stability of the surface. Exceptions may occur in areas of shallow workings, e.g. Tamfourhill Farm area, where the overburden is comparatively light, or in which roof support has not been removed. Subsidence may also be expected in those areas where mining is still active. There are small mines operating under licence at Woodend, working Hirst Coal; Airngath, working Spilt coal, and at Pitfirhill, where coal, blues and fireclay are worked. Since the workings of the Kincardine Colliery are beneath the sea, they will not affect surface development.

There are vast reserves of coal beneath the Growth Area which the N.C.B. propose to work. They are in the Upper and Lower Limestone Groups, and located in the area outlined on the Map 19 "Mining, Present and Future". The Board initially suggested that the whole of this area should be kept free from development but, in view of the necessary industrial growth in the area, were prepared to free the zone north of the Carron and west of the Forth shore, if appropriate compensation was paid for its sterilisation (see Map 19 "Mining, Present and Future").

The principal seam in the Upper Limestone Group is the Upper Hirst, which is an inferior quality coal, but suitable for steam raising. The seam is four to six feet thick, and at an approximate depth of 1800 feet. It is at present being worked in the north of the Area from Polmaise Colliery, and used in the Kincardine Power Station. There is at present no firm programme for the extraction of the main deposits underlying the Area, as this will depend on the demand from existing and proposed power stations. At a subsequent meeting with the Board, they suggested that, if extraction beneath the industrial site north of the Carron was limited to 60%, the resulting subsidence would occur gradually across the area producing a tilt of not more than 1:1000 at the surface, and an ultimate drop of only eight to nine inches. Tests have shown that suitably designed buildings should "ride" this "wave" without damage. A 60% rate of extraction means that the whole six foot thickness of seam is removed from strips 500 feet wide and of indefinite length, which alternate with parallel strips left for support, approximately 300 feet wide. At such a rate of extraction and consequent loss of mining rights, compensation would be payable to the Board. There are five seams of importance in the Lower Limestone group, with a total thickness of fifteen feet, and lying at an approximate depth of three thousand feet. They may be worked from the new colliery sinking near Airth. The starting date has been deferred by the N.C.B. and it is very unlikely to come into operation before 1985. The proposed "take" from this mine underlies Larbert, Letham, and Dunmore, and is shown hatched on the Map 19 "Mining, Present and Future". If there was complete extraction, subsidence at the surface would amount to between seven and eight feet.



Photo 21: Grangemouth Stadium

## RECREATIONAL OPEN SPACE

Recreation may be analysed in terms of the people who engage in it, their various activities, and the places in which it takes place. This section deals with the existing spaces, and is based on statistics supplied by the National Playing Fields Association and on direct survey.

### Distribution

The major element which can be considered on a regional scale is the Firth of Forth, at present used by boating clubs, at least two of which are domiciled in the Growth Area. Bo'ness and the River Carron are the main berths, with Dunmore as a subsidiary. Due to the lack of sand, excess of mud, and dirt in the water, the shoreline is not very suitable for traditional seaside activities.

Two other extensive areas are the moorlands and the agricultural areas of arable land, served by second class road and footpath systems: they are thus frequented by motorists, walkers and other casual users. These roads and pedestrian routes, which also include canal towpaths and the shore, extend beyond the Growth Area, and provide access to popular areas in the Campsie Fells and around Kilsyth.

Five major golf courses occupy further large areas, usually in rural surroundings.

The relative smallness of the settlements, and the accessibility of the open countryside are features of the Growth Area, and partly account for the comparatively low ratio of open space per person. The distribution of open space is shown on Map 22 "Existing Development 1965".

Parks and playgrounds vary in size, from less than a quarter of an acre to over forty acres, and vary in design from the immaculate ornamental to the windswept utilitarian. Bowling greens, football pitches and cricket grounds, and a new sports stadium support enthusiastic clubs and their respective leagues. A feature of the new sports stadium at

Grangemouth is the all weather surface: an innovation that is a great improvement on the muddy football pitches and play areas sometimes found elsewhere in the Growth Area.

From a study of most types of recreation, it is obvious that the great majority take place undercover, or are to some extent independent of the weather; the studies undertaken by Glasgow University confirm this. The few exceptions include football and golf, both of which inspire a loyalty among spectators and participants which defies the most arduous of conditions.

## LANDSCAPE

This section describes the Growth Area by classifying particular physical planning factors (which analysis has shown to be critical) into characteristic landscape types. Their distribution is shown on the Map 20 "Landscape Analysis".

### Landscape Types

The primary factors on which this study is based are Slope, Land Fertility, Woodland and Built-Up Area. A selection of that data has been drawn from the sections on Relief, Agriculture, Forestry and Settlements, i.e.

"Slope" is divided into "Flat"—areas with a slope of 1:20 or less;

"Sloping"—areas steeper than 1:20

"Land Fertility" is divided into "Fertile"—land of A+, A, B+, B quality,

"Poor"—land of B-, C, D, non-arable quality.

"Woodland" is divided into "Wooded"—land covered by or near high forest, plantations and tall scrub;

"Treeless"—land with no trees, or only isolated trees, hedges and dwarf scrub.

"Built-up Area"—all the major settlements, institutions, industrial areas.

From this data the following landscape types were plotted (see Map 20 "Landscape Analysis").

- Flat—fertile—treeless
- Flat—fertile—wooded
- Sloping—fertile—wooded
- Sloping—fertile—treeless
- Flat—poor—treeless
- Flat—poor—wooded
- Sloping—poor—wooded
- Sloping—poor—treeless

Secondary factors, water, orientation, steep slopes, re habilitation areas and historic sites were also plotted where appropriate. This Map is a generalisation based on the overall character of fairly large areas within which smaller areas of other types may exist. The first and most obvious characteristic of the Growth Area is its complexity which is partly due to the varying relief, and to the long history of human activity which has produced an irregular pattern of land-use. The relief results from the meeting and merging of three quite distinct types of topography, the flat carselands, the edge of the Slainsman Plateau, and the Kilsyth Hills. The land-use pattern is in turn influenced by relief, the distribution of superficial and subterranean deposits, and the climate.

#### **Flat—Fertile—Treeless**

The largest areas of this type are the fertile arable farms of the carselands extending down the eastern side of the Growth Area from South Alloa to Kinnell. The high fertility which makes them among the most productive soils in the country results from the deep deposits of marine clay sediments, or "raised beaches" which overlie the deeper boulder clays.

Much of this area has been undermined (see Map 18 "Mining (Past) and Outcrops"), and subsequent subsidence has caused bad drainage and a high water table, particularly between Towncroft and Heuck. The combination of soil type and moisture content has produced subsoils and peat deposits which will not support heavy structures. Being so near sea level, sea walls and river embankments are needed to prevent flooding at high tides and storms.

The scarcity of trees is probably due to the intensive cultivation of the soil and its high agricultural value. The whole of Grangemouth and parts of Falkirk are built on this type. Having little vertical relief, there are extensive views, and electricity pylons and the cooling towers of the oil refineries are very prominent. Exposure to wind is higher than in the wooded areas, and the carselands are prone to fog.

#### **Flat—Fertile—Wooded**

This type is devoted to intensive arable farming on the carselands and alluvial plains, and on a very few higher spots inland. The woodland is mostly of indigenous hardwoods in shelterbelts and policies associated with private estates. Natural woodland is restricted to small patches along river and railway embankments. This type is often adjacent to the previous one, but on slightly higher ground. The characteristics of this landscape include a mixture of long and short views, depending on tree density and altitude, a greater capacity for absorbing extraneous objects, and greater shelter than the previous type.

#### **Sloping—Fertile—Wooded**

This is a radically different landscape from the preceding areas, the element of "slope" accentuating many features. Among them is orientation, which affects the duration and intensity of sunlight; the

movements of air and water; extremes of temperature, and exposure to wind. South facing slopes in this category include areas of very high amenity. Northern slopes tend to be darker and colder, although some of them command extensive views across the Firth. Most of this type is arable or mixed farming, and contains the best examples of the gentle, sheltered, undulating, picturesque countryside.

Woodland is at a greater density than in the flat type because there are more uncultivable sites. These may be narrow and irregular in shape, have stiff clays, rock outcrop, steep slopes, areas of bad drainage, old quarries, or be the environs of country houses and farmsteads. Distribution roughly follows a wide, but incoherent belt from the slopes of Airmaght Hill in the east, round the edge of the Slainsman Plateau, and up to Turwood in the north, enclosing the low-lying flat land. The eastern parts on either side of Airmaght Hill are derived from boulder clay, and have the distinction of being "A" quality soils. They include the intensive small holdings at Champney.

#### **Sloping—Fertile—Treeless**

This is an exposed landscape of arable and mixed farms scattered on the slopes above the sloping—fertile—wooded belt. The soils which are mostly B+ and B quality are derived from boulder clay, or sand and gravel. These farms are still highly productive. Some, particularly near Loanfoot, have remnants of a shelterbelt system which has been allowed to deteriorate. The relief is of two distinct types, "moundy" on the sand and gravel deposits and "hill and vale" on the boulder clay. The land east of Polmont, and the areas round Shieldhill and Wallacestone are good examples of each. The lack of trees makes structures very apparent, and exposed to wind. Some of this type overlies the productive coal measures, contains abandoned mines and tips, and is often badly drained.

#### **Flat—Poor—Treeless**

The landscape within the "Poor" category may be divided broadly between "low quality agricultural land", and "non-agricultural land". The agricultural areas are mainly marginal farms with arable on B- and C quality soils, and rough pasture on the remainder.

The low fertility is due to a combination of bad drainage (which has resulted in areas of peat), rock outcrop, intractable boulder clay, thin soils on igneous rock, and exposure. Altitude is a critical factor; those areas above 400 ft. O.D. having significantly lower average temperatures, more and stronger winds and more rain. Most of these areas are found on the more elevated parts of the Area, on the northern edge of the Slainsman Plateau from Callendar, round Gardmu Moss, and Darnrig Moss.

The lower lying agricultural areas can be closely identified with the floor of river valleys, old tipping areas and peat bogs. The non-agricultural areas are on the salt and mudflats which extend along the entire coast line below and near high water mark: recreation areas and golf courses, industrial waste ground, and recently reclaimed land which is scattered throughout the industrial zones of the Growth Area.

#### **Flat—Poor—Wooded**

This type is found least, the poor soils occurring for the same reasons as in the previous type. The woodlands fall into three sub-types: Natural, Plantation and Estate, although these divisions are becoming more indistinct as amenity estate woodland is increasingly planted with commercial conifers.

Map No. 201 Landscape Analysis Key: 1. Forest, 2. Wooded, 3. Flat, 4. Sloping & Steep, 5. Power

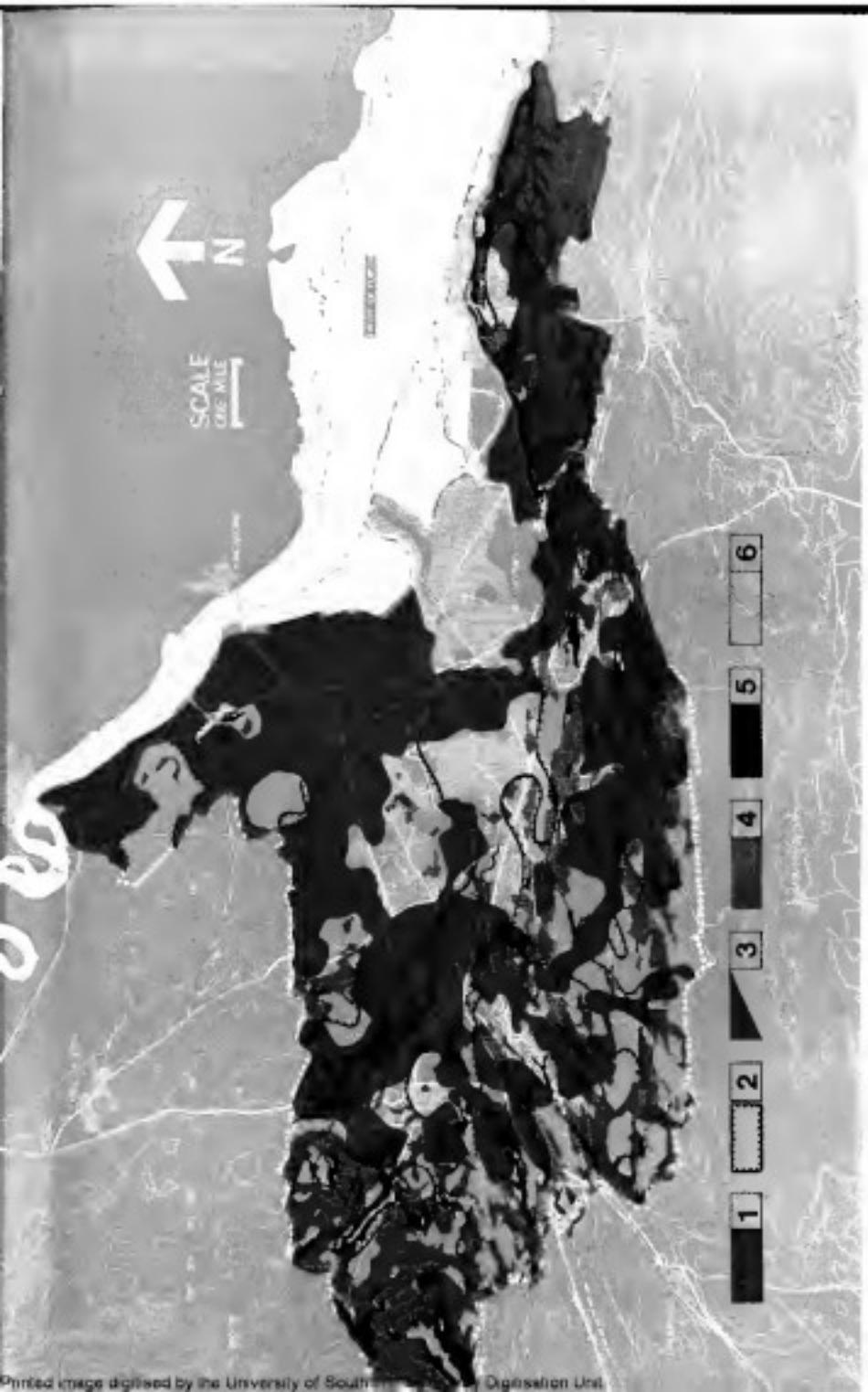




Photo 22: Union Canal



Photo 23: Playing field, north of Skinfats

Distribution is erratic, but nearly always associated with peat or boulder clay. The exception is at Callendar Park, where there is a large area of the "Estate" type on sand and gravel.

#### *Sloping—Poor—Wooded*

This includes the most attractive of the natural landscapes, particularly when associated with water, and a southern aspect. The woodland is of the three types already mentioned: Natural, Plantation, and Estate. It is the natural woodland found on the banks of the Rivers Avon and Carron and their tributaries which provides the best examples. Plantation woodland still tends to be of the dark monoculture Sitka spruce variety, although recent plantings at Tinternwood of Scots pine and larch add more variety to an already topographically interesting area. Most of this type of forest is dedicated.

Distribution is related to rock outcrop, steep river valleys on the upper reaches of the Carron, Cottlemuir Burn, and the Avon, steep slopes (often the edge of raised beaches), and to boulder clay, e.g. Castle Cary, and Rough Castle.

#### *Sloping—Poor—Treeless*

This type is mainly a rugged landscape of wild steep banks on heather and grass moorland and includes the highest parts of the Area. The lack of trees is due to grazing by livestock on the poorer soils and steep slopes, cultivation on the better soils, and exposure to wind, particularly above 800 ft.

The poor soils are a result of rock outcrops, slope and extremes of climate. The higher areas which rise to 1150 ft. O.D. have over 60 in. of rain per year (twice that of Blackness); several reservoirs are fed from this catchment area. Although not ecologically correct, this type could be described as a "wild natural landscape". The principal area forms part of the Kilsyth Hills at Denny Muir.

#### **Rehabilitation**

Rehabilitation sites are among the secondary factors which affect the landscape characteristics of an area. They may have an adverse effect on the amenity (e.g. rubbish tips); they may be a danger to health or limb (e.g. sources of air and water pollution, dangerous quarries); they may be liable to flood; they may have a potential for improvement and development (e.g. waste land); or they may be preventing development in their immediate or adjacent surroundings (e.g. pit shafts and areas liable to subsidence).

The processes of rehabilitation fall into two categories: physically changing an area in need of rehabilitation, either for its existing use, or for a new use, e.g. the demolition of derelict houses to make way for either residential or industrial development; and adapting neglected areas for new uses, e.g. the utilisation of a disused railway or canal network for a pedestrian walkway system.

The rehabilitation areas found in the Growth Area have been classified into the following types:

- 1 Bings—large mounds, usually of coal waste
- 2 Tips—places where refuse etc. is deposited
- 3 Derelict sand and gravel quarries
- 4 Disused railways
- 5 Derelict sites, waste ground, etc.
- 6 Ponds, basins, harbours, canals
- 7 Derelict stone quarries
- 8 Pit shafts and areas liable to subsidence
- 9 Land liable to flood, and badly drained areas
- 10 Certain poor quality soils
- 11 The foreshore, mainly mudflats between high and low water mark
- 12 Polluted rivers

These rehabilitation sites of regional significance at the time of the study are listed in Appendix 5 and identified on Map 88 "Rehabilitation Site Identification"; some of these may already have been rehabilitated, while others are currently in that process.

#### *Type 1—Bings*

The bings in the Growth Area are all connected with mines, and their distribution is directly related to the underlying coal seams. Their size is inversely proportional to their age: the smallest and oldest being found round the shallow workings of the early industrial age, e.g. Airliehill Hill; the largest and most recent adjacent to mines still being worked, or recently closed (e.g. Kinnell and Callendar Policy). With the exception of the former, which are mainly grass and tree covered, they all have an adverse effect on the amenity, often occupy valuable sites, and are sometimes a source of air pollution. The larger bings fall into three classes:

##### *Coal Bings:*

These have already been surveyed by contractors, and some containing a large proportion of coal are being quarried and screened. A washing plant is at present working at Bonnybridge and another is due to start at the Callendar Policy Bing, Falkirk.

##### *Derelict Bings:*

These bings contain a high proportion of stones, or have been burnt and reduced to clinker, and are suitable for foundations and infilling. Some of them are being quarried by contractors.

##### *Soft Bings:*

The remainder of the bings are composed of soft unburnt material or ash, which may have low load bearing qualities.

#### *Type 2—Tips*

There are two types of tip in the Growth Area:

##### *Works Tips:*

These are mainly found in association with fireclay works (e.g. at Bonnybridge) or with iron foundries (e.g. at Carron). The main factor in their location is ease of waste disposal; reclamation is seldom considered. Occasionally they contain salvagable materials, as at West Carron.

##### *Rubbish Tips:*

These are usually found in hollows and quarries, and are used for municipal refuse, spoil, and rubbish. Disposal is in most cases combined with reclamation.

The works tips have an adverse and long term effect on the amenity of the Area, and often adjoin railways and busy roads. The refuse tips may have a similar effect, unless they are under controlled conditions when they should be unobtrusive.

#### *Type 3—Derelict Sand and Gravel Quarries*

Most of the abandoned workings are at present being rehabilitated by backfilling with refuse, coal screenings and spoil. The time taken by these operations is variable and the amenity of an area, like Bonnybridge, for example, may be affected for years.

#### *Type 4—Disused Railways*

There are four disused railways in the Growth Area, excluding numerous abandoned sidings. The lines near Shieldhill are part of an extensive system which ramifies through the Slamannan Plateau connecting defunct mines. There is another section running from Denny Loanhead to Rouchmire.

#### Type 5—Derelict Sites and Waste Ground

These are usually in transition between abandonment and redevelopment; though others, for some reason, are unsuitable for development. There are a few large areas (like the disused railway sidings at Bo'ness) and many small sites within the towns. Bo'ness alone has more than thirty.

#### Type 6—Ponds, Harbours and Canals

The only ponds to be rehabilitated are those at Grangemouth, which were used for timber seasoning. Preparations for this scheme are well in hand.

The docks and harbour at Bo'ness are the major item in this group: part of a general area of dereliction, they have been silted to an extent which interferes with their uses by small boats, and detracts from their appearance.

There are two canals in this Growth Area: the Union, and the Forth and Clyde. The Union Canal runs from the centre of Edinburgh to the south of Falkirk, passing through the Lothians Survey Area and Linlithgow. It is owned and maintained by British Waterways, who supply water to industry, mainly in Edinburgh. Boating rights are also leased.

There is no public right-of-way along the towpath, but no exception is taken to those who use it at their own risk. Due to the high risk of serious accidents, however, three major aqueducts carrying the canal across valleys have been closed to pedestrians. These are at the Water of Leith, Edinburgh, the Almond River near Newbridge, and the River Avon near Linlithgow. A canal tunnel linking Glen Village with Falkirk is still open.

The Forth and Clyde Canal runs from Grangemouth to Glasgow, but is no longer navigable, due to the closure of locks and culverting. About one mile of its eastern extremity is to be infilled by Grangemouth Burgh Council.

Both canals suffer from vandalism, including the regular destruction of boundary fences, and dumping of rubbish. In spite of this, both canals are a valuable scenic and recreational asset.

#### Type 7—Derelict Stone Quarries

There is only one quarry of significance (at Thorneydyke) and this is being filled with refuse. There are, however, many small quarries throughout the Growth Area which do not detract from their surroundings, and may be useful for recreation purposes.

#### Type 8—Pit Shafts and Areas Liable to Subsidence

These areas are recorded on Map 18 "Mining (Past) and Outcrops" which shows where coal outcrops are near the surface and may contain old workings, and areas in which pit shafts have been recorded. Some of these areas have become scrub or woodlands.

#### Type 9—Land Liable to Flood, and Badly Drained Areas

Flooding is due to three main causes: rivers and streams overflowing their banks, high water tables on low flat ground, and hollows lined with impervious soils. Grangemouth and Rumford both suffer from the first type, and schemes are in hand to prevent recurrences. An extensive area of the second type is found north of the Carron near Skinflats, where permanent waterlogging is aggravated by heavy rains and high tides. Many small areas of the third type occur on the alluvial soils next to rivers, the boulder clays near Torwood, and the edge of the Slamannan Plateau.

#### Type 10—Poor Quality Soils

The southern section of the Growth Area forms part of the Slamannan Plateau, an elevated area of some forty thousand acres. It extends westward to Airdrie, eastward to Bathgate, and is roughly bisected into north and south parts by the River Avon: the village of Slamannan lying at its centre.



Photo 24: Dereliction at Bonnybridge



Photo 25 Near Mungai Farm, Fallirk (site of the proposed Central Park)



Photo 26 Northern margin of the Slemmanan Plateau

Because of exposure to wind, and poor soil conditions, the land-use is mainly marginal agriculture, woodland is scarce and there are large areas of peat and grass moor. The landscape generally is of the flat and sloping—poor soil—treeless types. Peat moss is often associated with the flat areas. The slopes are rocky outcrops, thin skeletal soils, and boulder clays. The extreme exposure is primarily due to the lack of protection from surrounding higher hills, not altitude, since there are many adjacent higher areas in the Southern Uplands with a better climate. The poor soil conditions are due to a combination of climatic factors, and the impervious nature of the boulder clay. Lack of woodland can also be attributed to exposure, adverse soil conditions and the grazing of livestock.

#### Type 11—The Foresore

There are six main areas of mudflats along the Growth Area's shore line but only those between Bo'ness and low water mark, and along the lower reaches of the River Carron seriously affect the amenity. Schemes were considered to reclaim the area west of Kinneil by a sea wall, but were abandoned on technical and financial grounds. Part of that area is at present being reclaimed by tipping.

#### Type 12—Polluted Rivers

Both the main rivers in the Growth Area are polluted by industrial wastes, and the Carron also by sewage. With the recent introduction of new legislation and the provision of new sewage works and plants for treating industrial effluent, these nuisances should eventually disappear.

### HISTORIC INTERESTS

There is much archaeological evidence to prove that the Growth Area has been inhabited since the end of the Ice Age when Neolithic Man established himself there. Antiquities found in the Area include dug-out canoes belonging to primitive hunters and kitchen-middens made of oyster and mussel shells (Neolithic Age); and weapons of stone and bronze from the Stone and Bronze Ages. Graves from the Bronze Age Era have been unearthed near Cramond. The Area also contains numerous structures associated with more recent times, including the Roman Occupation, the Middle Ages and the Industrial Revolution. Of these, of greatest historical importance are the Roman Wall, James Watt's Cottage and Boiler at Kinnel, and the Canal System. The historical development of the Settlements has been described in the Chapter on Settlements, and a brief history of the Canal System appears in the Chapter on Canals and Ports: it is not proposed therefore to discuss these aspects in this Chapter.

#### The Roman Wall

In AD 85 Agricola advanced as far north as the Firths of Forth and Clyde, and across the narrowest part of Scotland he constructed a line of forts and earthworks which were however abandoned before AD 100. In AD 142 Quintus Lollius Urbicus began to construct the Antonine Wall as a defence against the warlike northern tribes. The Wall stretched thirty-seven miles from Beldingess on the Forth to Old Kilpatrick on the Clyde. It consisted of a ditch (usually twelve feet deep and forty feet wide) on the north; a rampart (fourteen feet broad at the base and usually about ten feet high); and a parapet. On the south side of the defence system ran a paved Military Way, roughly parallel to the Wall, at a dis-

tance of forty to fifty yards, for its entire length. The materials used were those most convenient to the site: west of Castle Rough, turf on a stone foundation fourteen feet wide; east of Rough Castle, a stone foundation for the greater part of its length, but with a layer of clay covering the stone: stone was never used for the upper part of the Wall. After the Romans abandoned the Wall before AD 200, it quickly fell into disrepair and much of its masonry was taken by local builders.

The Wall had nineteen stations, or forts, at roughly two-mile intervals with some smaller works between them at significant points. There were also a number of temporary camps south of the Wall which may have been used by the builders. All the ten forts excavated had principal buildings at the centre of the internal area. These were usually of stone with heavy red-tiled roofs and included the Headquarters Building, containing one or two courtyards, and a range of small rooms (one of which contained the shrine); and the Commandant's house and granaries. Within the fort were workshops, stores, barracks, and at least one suite of baths. There are four known sites of forts in the Growth Area: Castercary, Rough Castle, Muirmills and Cramond, with four others assumed to be at Seabegs, Falkirk, Inveravon and Kinneil.

Castercary is one of the only two forts on the Wall which had stone walls and towers. The buildings in this fort included the Headquarters, a granary, latrines and baths. A stauette, an intaglio and various inscriptions have been found here. Castercary was the strategic centre of the Wall and a military way probably ran south from here to join the main road to Carlisle near Carlisle.

Rough Castle (now in the care of the Ministry of Works) commanded a site of great strength, although the fort itself was unusually small; it is the best preserved of all the Antonine Posts. Its rectangular area, of little more than an acre, was defended on the north by a great rampart and ditch, reinforced by a series of defensive pits; adjoining ramparts were probably made independently.

The interior contained the Principia, at the centre; the granary, west of the centre, with the Commandant's house further west. Within the Principia was the Sacellum, the shrine of the Standards and the Regimental Bank. A suite of baths was probably in the annexe. The interior was divided by the military way. A platform (probably used for signalling) once stood immediately west of Rough Castle. This was seventeen feet square and built of turf set on a stone base.

Remarkable kilns for burning bricks were found at Muirmills and its principia was one of the largest in Britain for an auxiliary fort. The fort was the largest on the Antonine Wall.

Cramond Fort was about 1100 yards north of the Wall, lying on the military road which connected the Antonine Wall to the Ardoch Camp in Perthshire. The fort was strategically sited on the edge of steep banks overhanging the River Carron and was composed of a main camp of nearly six acres with an annexe to the south of over eight acres. Both areas were surrounded by strong entrenchments. The main camp had an entrance on each side, with streets of hard gravel paved near the entrances. The houses were built of hewn stone and some were warmed by hypocausts. There was an admirable drainage system. Fragments found at Cramond include window glass, red roofing tiles, pottery, bronze and clay lamps, beads and bangles, studs and brooches, harness mountings, tools and weapons.

Watling Lodge was a "guard house", which stood midway between the forts at Rough Castle and Falkirk, at the point where the Roman Road passed through the frontier to Cramond.

At the end of the Wall at Bridgeness a large stone was found inscribed in Latin: "To Emperor Caesar Titus Aelius Hadrianus, Antonius Plus, Father of his country, the second legion". Evidence of a civilian settlement growing up alongside a fort can be seen at Carriden where an altar was found, set up to the god Jupiter (now in the National Museum of Antiquities, Edinburgh), which gives the name of these forts—*Velumia* (the only Roman place name we know on the Antonine Wall).

"Arthur's O'on", which stood near the Carron Iron Works until 1743, was a beehive structure, about ninety feet in circumference at the base, and twenty-two feet high, with a round opening twelve feet in diameter at the top. There was an arched doorway nine feet high, with a window with sloping sides above it, built of hewn and coursed freestone, without mortar. This was a Roman "victory" monument and probably one of the finest Roman buildings in Britain. There is a replica of it on the roof of the stables at Penicuik House, Midlothian.

#### *Remains of the Wall*

Barely any trace of the Military Way remains in the Area. Of the Wall, the Ditch can be most clearly seen, and the Rampart is visible for short lengths. The Ditch can be seen in the grounds of Kinnell Estate; between Kinnell and Inveravon, at Cowbank and at Summerhouse Park; between Polmonthill Cottage and Polmonthill Farm (one of the best preserved stretches of the Ditch); in the grounds of Callendar Park (in very good condition); in the grounds of Bantaskine; west of Lock Sixteen on the Forth/Clyde Canal and the site of Watling Lodge (the finest condition of the whole length) under the guardianship of the Ministry of Works; beside the Falkirk/High Bonnybridge Road; 220 yards west of Tayvalis (preserved and often in very good condition for a mile and a half); in the Tenthfield Plantation, remains of one of the turf platforms attached to the rear of the Wall; around Rough Castle (very well preserved); about a quarter of a mile west of Rough Castle and just inside the grounds of Bonny-side House (remains of two of the signalling platforms, with surface traces of gravel pits); west of Bonny-side House; in the grounds of Seabegs Place; well preserved stretch of the Wall, Ditch and outer mound in Seabegs Wood (owned by the National Trust, under the guardianship of the Ministry of Works); now Underwood House to Casteley School (traces only). From west of Lock Sixteen on the Canal to Bonny-side House is the most important length of the remains, in spite of short interruptions.

In the visible remains only a glimpse of the wealth of resources possessed by the Antonine Wall both for archaeological research and for display can be seen. Except for urban development (e.g. at Bo'ness and Falkirk), and civil engineering (e.g. the Forth and Clyde Canal), the stone base of the rampart is probably almost continuous, even where agriculture has removed all trace of the works. The Wall makes quite an impact as it is, but given a planned programme for adequate display (which the Ministry has in mind), it could be much more striking, and certainly more comprehensible to the non-specialist visitor.

#### *Celebrated People Connected with the Area*

James Watt, the inventor, and Dr. Roebuck, founder of the Carron Iron Works, effected a number of important improvements to the steam engine in an outhouse in the grounds of Kinnell House. Watt's first engine for winding coal was installed at Roebuck's Burn Pit in 1768. Other famous people connected with the Area include Dugald Stewart, the philosopher; Robert Henry, the historian;

James Bruce, the Abyssinian explorer; Major Shrapnel, who designed the shell to be named after him at Carron; and William Symington, who designed the machinery for the first practicable steam ship "The Charlotte Dundas" (1789). Mary Queen of Scots and Bonnie Prince Charlie were both frequent visitors to Callendar House, once the home of the Livingstone family.

#### *Historic Remains (See Appendix No. 7)*

Historic remains in the Area include the Steeple of the old Town Kirk in Falkirk, the only surviving building of the ancient Burgh; Kinnell House, once a royal retreat and home of the Dukes of Hamilton, which contains in its one remaining wing some sixteenth century religious murals, and coats of arms of the Hamilton and Douglas families dating from the same era; the twelfth century Norman church at Airth; and the tower of Casteley and castles of Stenhouse, Toewood and Airth, all in various stages of disrepair. There is also a circular mound east of Seabegs House where a Norman castle once stood.

## SCIENTIFIC INTERESTS

Although there are no classified Sites of Special Scientific Interest in the Growth Area, the natural return of wild life could be readily encouraged in certain areas, provided that certain improvements are made (i.e. by tree-planting a variety of species which would encourage different flora and fauna).

#### *Suggested Areas for Conservation*

The main areas where natural life is most likely to thrive are described below (see Map 21 "Scientific Interests"):

Callendar Wood provides a variety of oakwood fauna and flora, very suitable for teaching purposes.

The woods round Castle Cary, probably the natural remains of the Caledonian Forest, are principally oak and rich in oakwood and other flora, which in turn encourage a variety of fauna.

The Aeon Gorge is an interesting area, particularly on its south-facing slopes where the wealth of plants include *arum maculatum*, *daphne laureum*, *ilium martagonium*, and *impatiens*. The Gorge is also rich in typical oakwood fauna.

Kinnel Wood, once an attractive oakwood stretching into Bo'ness, is being felled and replanted with spruce.

Tor Wood consists mainly of pine and hardwood, but has been heavily felled and is in need of attention. In spite of this, it contains a wide variety of habitats, and a good selection of ferns and mosses. This area is of considerable interest though the Nature Conservancy has not recommended it as a Site of Special Scientific Interest, and it is felt that it should be replanted as an oakwood. There is a resident scout camp in the Wood.

Lesham Moss, Larbert, was planted with fir and spruce in 1915, but was later destroyed by fire, and is now merely an expanse of moss. This however has great potential as an adventure area.

The Union Canal, near Falkirk, has great potential for recreation if cleaned and restocked with fish and other aquatic life, and if its banks were planted, would probably attract a wide variety of interesting fauna. The striped Zebra mussel (*Dreissena polymorpha*), introduced to the Canal many years ago, may still be found.

#### *Faunal Interests*

The flotation ponds at Grangemouth contained a wide selection of faunal species as a result of washing Canadian timber: in particular a small snail



Map No. 27: Scientific Interests Key 1 Areas suggested for nature conservation

(*Bithymia Leachii*). It is probable that the numbers were higher before DDT spraying during the Second World War, and the species may vanish altogether now that the ponds are to be filled in, as a result of the Council's proposed redevelopment of the area.

Mallard, teal, wigeon, pintail, pochard, tufted duck, goldeneye, goosander, merganser, shelduck, greylag, and pink-footed geese, mallard and whooper swan frequent the Firth Estuary from Grangemouth to Kincardine, moving from shore to shore according to tides and local disturbance. Shelduck are particularly common on the mudflats at Grangemouth, which is also a favourite roost for greylag and pink-footed geese which feed along the silty plain as far as Alloa, though their numbers have recently declined because of increasing disturbance from industrial activities. The arable plain which stretched

along the shore from Grangemouth is used as a daytime roost by dabbling ducks disturbed from the river; diving ducks, however, are not so readily unsettled and frequently stay on the river during the day (see Table No. 1). Large flocks of mallard are known to frequent the Carron Valley Reservoir and three to four hundred greylag geese have been reported, feeding in the young *fe plancatuum* on the surrounding hills.

## PLANNING IMPLICATIONS

### Settlements

Most settlements are within a short distance of each other and because development is very nearly linked in many parts, it may be undesirable to

TABLE 1 Wildfowl in the Area

Carron Valley Reservoir (18 miles)

	Mallard	Teal	Wigeon	Pochard	Tufted Duck	Goldeneye
Regular	175	15	30	—	10	3
Maximum	1,000	200	300	15	50	25

Firth Estuary (Grangemouth, Kincardine, Kincraig, Alloa and Devon Marsh)

	Mallard	Teal	Wigeon	Pintail	Pochard	Tufted Duck	Goldeneye
Regular	1,500	2,030	895	170	40	535	540
Maximum	3,000	5,500	1,600	490	160	1,500	825

	Goosander	Merganser	Shelduck	Greylag Goose	Pinkfooted Geese	Mute Swan	Whooper Swan
Regular	10	85	790	250	1,200	345	135
Maximum	30	230	1,870	500	1,700	390	345

conserve a policy of urban expansion for each separate Borough, especially when there are advantages to be gained from a cohesive urban complex.

Since the intensity of urban development is low (reflecting extensive industrial areas and low rise housing), considerable growth potential will be offered from increased residential densities and more intensive industrial land use, both in urban renewal and in new development.

Few urban areas have outstanding character or architectural interest and it is therefore all the more important to conserve the best of past development.

As the settlements generally have few areas of early origin which are therefore suitable for immediate redevelopment, improvements of the built environment that may be needed may have to be achieved by environmental management, and/or the alleviation of nuisance at their sources.

Housing is mostly low-rise with little variety in layout or design, but those few examples of well designed housing which have recently been completed could be taken as examples showing how the motor vehicle can be satisfactorily accommodated and adequate social and recreational facilities integrated within a visually attractive environment.

Most of the central areas are domestic in scale and lack servicing and parking facilities; so alleviate traffic nuisance and provide a wider range of facilities for the population growth extensive renewal will be necessary.

Industrial development is generally dispersed, often to the detriment of the surrounding adjoining land-uses. Where improvement is impossible, industries will need to be phased out and replaced by a conforming land-use which makes full use of the available site. New industrial development should be much more concentrated, linking with present sites where possible.

There are areas of sensitive landscape adjacent to, and within, built-up areas which should be exploited by improving access for regional recreation; by the careful design of nearby development to provide for onward views or to incorporate significant topographical features; and by conserving woodland and mature vegetation wherever possible.

## Special Aspects of the Environment

### Air Pollution

In Bonnybridge and parts of Falkirk and Grangemouth where air pollution arises from industrial sources, residential development should not be undertaken where it is likely to be adversely affected. Nor should industrial development be undertaken where associated pollution is likely to promote nuisance. The motor vehicle is also a major source of air pollution, and heavy traffic in urban areas should therefore be re-routed wherever possible to allow maximum natural dispersal.

### Micro-climate

Environmental conditions are less pleasant on steep north-facing slopes, in windy areas, in frost pockets and at higher elevations; these areas should not be developed for residential use, unless satisfactory remedial measures can be taken. Conditions are most pleasant on south facing slopes, in sheltered areas, and generally below 400 ft. O.D. These areas will be most suitable for residential development.

### Safety

Traffic creates the greatest hazard to safety in urban areas and satisfactory pedestrian-vehicular separation will be necessary in areas likely to experience unresilient heavy traffic volumes. Safe access

will need to be provided at all points of pedestrian attraction. In residential areas, traffic should be kept to a minimum.

### Noise

Because urban noise is an increasing source of annoyance and because road traffic accounts for the highest level, vehicles should be canalised wherever possible to locate the source of nuisance away from residential areas. The design of buildings and layouts likely to be subjected to high noise levels should include provisions for noise reduction.

### Agriculture

Many more people will be going into the countryside for recreation. If this movement is to be controlled, some administrative system may be needed to negotiate access agreements, maintain rights of way, prevent damage and educate the public.

The hill farm areas are probably more attractive somatically, and less liable to damage than arable crops. They may be more suitable for some forms of public access.

In general rural areas are attractive to town people, and recreational routes, and stopping places for cars and pedestrians may be developed through them.

Since the area devoted to agriculture is strictly limited, and not appreciably extendable, it should be conserved as far as is compatible with development needs.

The areas of poor soil and marginal agriculture may be upgraded by improvement methods, developed for forestry and/or made into recreation areas.

With an expanding population, there may be an increase in dairy farming and horticulture.

### Forestry

There are relatively few trees in the Growth Area and because their amenity value is high, they should be preserved wherever possible.

The shelterbelts and semi wooded areas are linear in form, and may be useful as part of the pedestrian recreation system, or as boundaries to developments.

Many of the woodland areas are scenically attractive and may be useful as recreational open spaces.

Woodland can ameliorate local climate, and improve the general amenity, and may be considered necessary round the treeless settlements.

Shelter planting can improve agriculture, and may be considered in the "poor" and "non-arable" treeless areas.

### Residential

Because only a small proportion of dwellings are more than thirty years old and these are relatively few under houses, it is unlikely that any extensive areas will become ripe for redevelopment within the period of the Plan. Any substantial increases in population will therefore have to be accommodated outside existing urban areas.

Since the provision of community facilities will be necessary on a more comprehensive basis and there is only a limited amount of suitable building land available, it may not be possible to accommodate the future population at the relatively low densities at present found in the Area.

There is a shortage of "middle-income" housing to meet the current demand and it will be necessary to provide more prime housing for sale or rent, both to balance the present population structure and to cater for the rising demand for this type of housing in the future.

Many residential districts suffer from harmful influences: air pollution, high traffic volumes, noise, poor micro-climate, poor outlook. Where reduction in nuisance to acceptable levels is not possible, these areas should not be redeveloped for housing. New housing sites should be chosen to avoid these shortcomings, and should incorporate pedestrian/vehicular separation whenever possible. The few well designed housing areas which satisfy these environmental requirements should be regarded as examples for future schemes.

Early Local Authority housing estates fall below present acceptable standards of function and design: most of the more recent schemes are expected to become environmentally sub-standard within twenty years. It may therefore become necessary to improve the environment of these housing areas before they become ripe for redevelopment. Where improvement of such areas is not possible within acceptable cost limits, they should be included in comprehensive redevelopment schemes.

## Social Facilities

### Shopping

Most shopping centres have inadequate premises and suffer from traffic nuisance causing air pollution, noise and danger. The improvement of conditions for safe and convenient shopping may necessitate redevelopment or extensive alterations, including the provision of pedestrian precincts, acceptable vehicular access, parking and servicing arrangements. Some of the Area's shopping centres incorporate these features and these should be regarded as examples for future schemes.

Most outlying residential areas have little choice in shopping facilities and many are served only by travelling shop or the co-operative store. Whilst some improvement of shopping facilities is expected in these areas as a result of greater affluence, the influx of a larger supporting population will give the opportunity to achieve a better distribution of facilities as well as the standard of shopping desired.

Falkirk Central Area has charm and character and is worth preserving. With extensions to the traffic-free areas, it could provide the basis for a satisfactory regional centre.

### Health

Developments in medical treatments are expected to lead to a greater diversification in the use of hospital buildings, and since many of the Area's hospitals are situated in extensive grounds it may not be necessary to allocate further land for this use.

Most hospitals in the Area are satisfactorily served by road and public transport. Future communication networks should however ensure that accessibility is further improved, especially to the hospitals in Falkirk and Larbert.

### Education

There is little spare capacity and a scarcity of up-to-date facilities in the existing school provision: an extensive population increase will therefore require additional schools to be built concurrently with housing development. This will provide an opportunity to improve the general distribution of schools in the Area; to reduce the average journey; to develop a convenient and safe footpath system from home to primary classroom; and to locate secondary, Roman Catholic, private and higher education institutions to take full advantage of the envisaged transportation facilities.

The increase in population will require a wider range of educational facilities to be provided at all levels, and should eliminate the need to travel beyond the Area for all but University needs.

## Industry

Although industry is a dominant land-user, there are large areas of land zoned for industry which are under-used or lying derelict, and it may be possible to satisfy some local needs for industrial expansion by fully using the present potential capacity.

Because the older industries (extractive and metal manufacturing) are declining, and there are few light manufacturing concerns, new industrial sites should be selected to encourage the gradual diversification of employment, particularly to provide a wider range of job opportunities for females.

The concentration at Grangemouth of capital intensive industries with a very low employment ratio, suggests that industries being attracted to the Growth Area might have similar characteristics. A generous scale of industrial land should therefore be zoned to allow for this possibility.

A number of residential areas adjoining industrial zones are affected by pollution, noise, smell, and effects of heavy traffic, and special measures will be necessary to ameliorate these unpleasant conditions and, should obnoxious industries be attracted to the Growth Area, these should be located in zones which will not affect residential areas.

Many industrial areas suffer from traffic congestion, lack of parking space, out-moded premises, and a generally unpleasant environment. To attract new growth, management and workers, these disadvantages will need to be overcome, and a higher standard of design and layout adopted. In some cases improved access roads and transportation facilities may be required.

## Mining

Detailed investigations and clearance will be needed in all areas not already cleared by the N.C.B.

Because there are areas containing greater difficulties, e.g.:

- (a) areas of known recorded shallow workings, e.g. Tamfourhill;
- (b) areas of known, but unrecorded workings, e.g. Stenhousemuir;
- (c) areas near outcrops which may contain old unconsolidated workings, e.g. Bo'ness,

special investigations will be needed to prove them suitable for developments, including site surveys by borers and probes.

In areas of unconsolidated workings, the following alternatives may be considered:

- (a) That they are unsuitable for development.
- (b) That if the workings are near the surface, e.g. 20-60 feet, piles may be driven through them to below pavement level.
- (c) That the workings may be filled with grout.
- (d) That if the workings are deeper, e.g. 100 ft, and the overburden and overlying rock are sufficiently strong, light structures may be erected.

In view of possible mining under the area north of the Carron, consultations with the N.C.B. will be necessary before development proceeds.

## Recreational Open Space

The proximity of the sea and the under-used foreshore facilities at Bo'ness indicate unlimited potential for marine activities.

The legal status of many walkways is uncertain, including the canal towpaths, and it may become necessary to establish access rights in some areas.

The countryside will be increasingly used for recreation and the Local Authorities may have to accept greater involvement and responsibility for conservation, supervision and development of facilities.

Unfavourable climatic conditions and increased urbanisation will probably demand changes in the designs of recreational open space. This will probably lead to further intensive use, requiring undercover facilities, illuminations and increased coaching, supervision, etc.

Many recreational components of the Growth Area have a linear form: the Antonine Wall, the Canals, the Firth Foresore; and these could become important constituents of a comprehensive pedestrian walkway system for the Growth Area as a whole.

## Landscape

### Landscape Types

"Flat—fertile and poor—treeless" areas are likely to be the most suitable for industrial development.

"Flat—fertile and poor—wooded" areas are likely to be the most attractive for large scale residential development.

"Sloping—fertile and poor—wooded" areas are likely to be the most attractive for low density residential development.

"Flat and sloping—poor—wooded" areas are likely to be the most attractive for intensive but "non-organised" recreational use.

"Sloping—poor—treeless" areas, especially those with steep slopes, are likely to be very useful for "low density" recreational use.

## Rehabilitation

The demand for building sites within the urban area will result in many of the derelict areas being rehabilitated by the normal development processes.

The remainder may require action by the Local Authorities.

The increasing demand for foundation material, and for cheap coal, will result in those bings containing hardcore and coal being gradually removed, providing in some cases sites for redevelopment.

Those which are unsuitable for building development may be considered for recreational use.

The rapidly increasing volumes of domestic and industrial refuse will intensify the demand for tipping areas. These could seriously affect the environment unless they are controlled, phased, and co-ordinated.

The exploitation of the large deposits of sand and

gravel in the Growth Area may produce many more sites for rehabilitation.

The old railways may have a potential for recreational use, and a detailed investigation of the Stanseeman network may be desirable.

Harbours and canals are elements of great attraction, and their inclusion in the recreation system should be considered.

Some areas affected by pit shafts and subsidence may be suitable for development but then may need treatment.

Areas of bad drainage and liability to flood may also need treatment before development.

The mudflats may provide useful sites for the disposal of refuse and ultimate reclamation.

The shoreline has value as a recreation and amenity feature, and special consideration will need to be given to the designation and designing of the immediately adjacent areas.

Because the rivers are polluted, their full potential as recreational features cannot be achieved.

## Historic Interests

The Antonine Wall has considerable historic importance and archaeological interest and special measures may be necessary to protect it from the effects of any development in its vicinity. With its linear form and its historic and romantic associations the Wall has considerable recreation potential, particularly if related to a variety of other recreational uses.

There are significant historical associations between some of the Growth Area's factories and the Industrial Revolution and several of these early buildings and pieces of machinery may be well worth preserving.

## Scientific Interests

There are few areas of scientific interest in the Growth Area, and it may therefore be necessary to safeguard these as potential "banks" of wild life, subsequently to be used for scientific, educational and recreational purposes.

Because of the scarcity of scientific interest, it may be desirable to encourage special areas which would harbour representative plant and animal communities.

## 3. Infrastructure

### PUBLIC UTILITY SERVICES

#### Electricity Supply

The supply of electricity is the responsibility of the South of Scotland Electricity Board, which serves all developments within the whole of the Central Belt.

Various power plants, coal and oil fired, nuclear and hydro-electric, provide electricity for Central Scotland. Within the Growth Area, at Bonnybridge, the old generating station has become an important node for power lines because of its geographical location.

Following a comprehensive study of possible load development and grid transmission system undertaken in 1957, the decision was taken to establish a super grid network within Central Scotland operating at 275 kV, but capable of being

uprated to 400 kV. The erection of this supergrid is now complete and its route goes through the Area. The supergrid is a feeder which brings the energy to the existing grid complex. The existence of all the various grids is therefore still necessary. The distribution system for both overhead and underground cables is shown on Map No. 23 "Electricity Supply".

There are three joint transmission and distribution sub-stations, at Grangemouth (Wharfies), Birkenside and Bonnybridge. Distribution substations at Falkirk, Grangemouth, Larbert, Denny, Greenhill and Bo'ness, centrally located within the respective urban developments, serve both domestic and industrial needs.

The South of Scotland Electricity Board estimate that their arrangements are appropriate for coping with development which is at present anticipated in the Area.



Photo 27. Bonnybridge Power Station

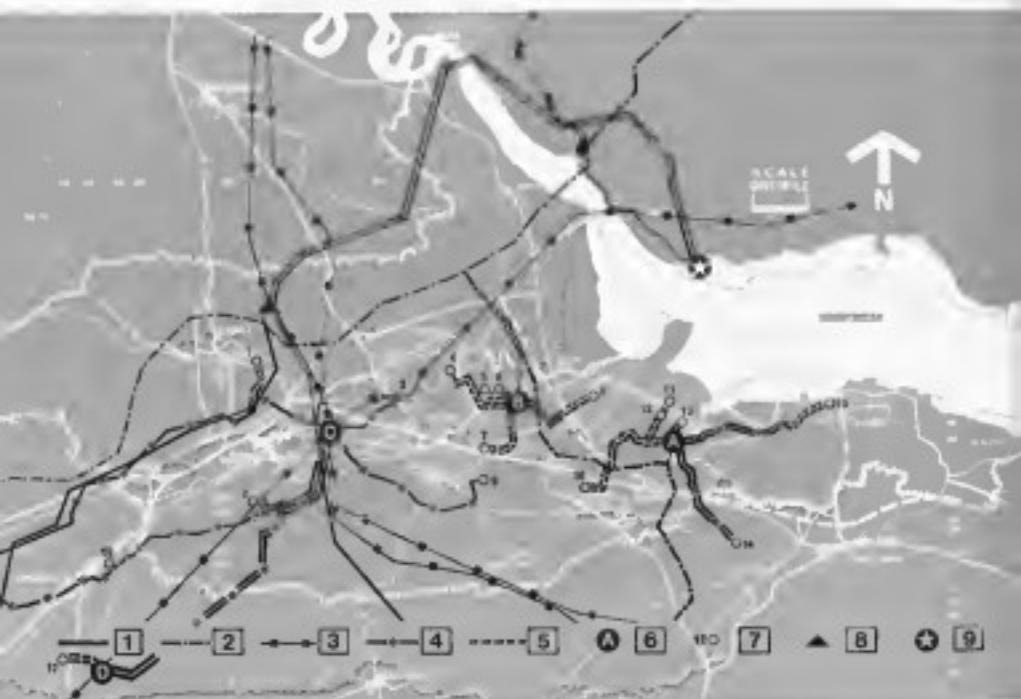
The construction of a 400 kV link between the new generating station under construction at Longannet and the existing grid system does present a problem which affects development. Two 400 kV lines will cross the River Forth in the vicinity of South Alloa, then continuing in a southern direction via Denny and Bonnybridge.

#### Water Supply

There are two well developed major water supply systems: the Stirlingshire and Falkirk Water Board, served mainly by the Carron Valley Reservoir, which supplies a large part of the present require-

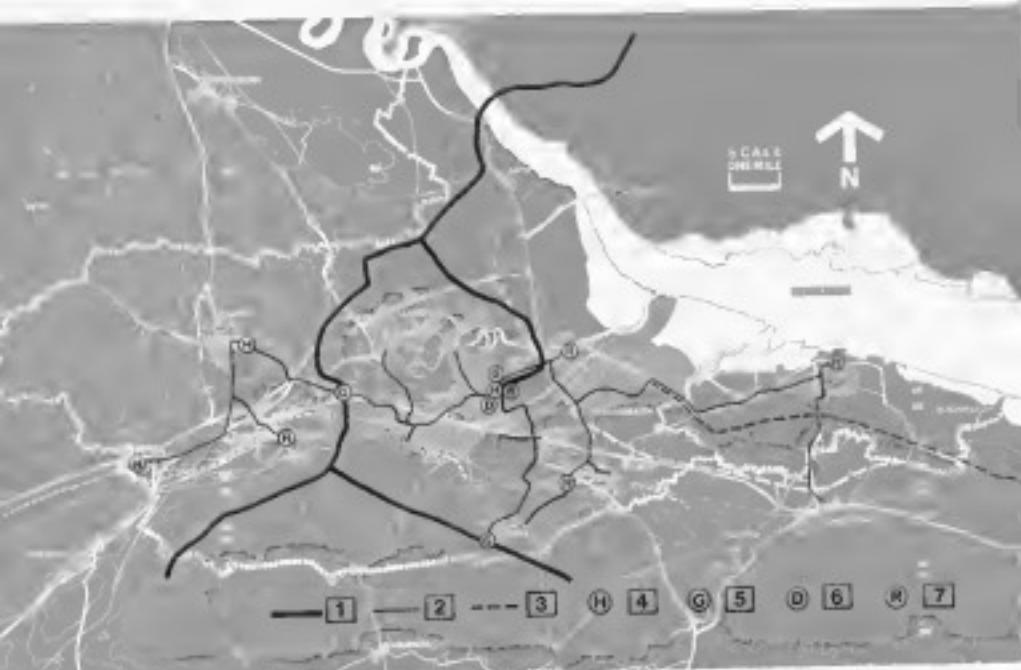
ments in Falkirk, Grangemouth and other built-up areas in the County; and the Loch Turret Water Board, which supplies most of its yield to Grangemouth. The West Lothian Water Board supplies some of the landward areas in the east, while the Burghs of Grangemouth, Be'ness and Denny have their own local water supplies which provide for part of their needs. (See Map No. 24 'Water Supply').

The Stirlingshire and Falkirk Water Board's net safe yield of headworks, after deduction of compensation water, amounts to 23,165 million gallons daily. Its total commitments are over 21.7 million gallons daily, thus giving an available surplus of





Map No. 24: Water Supply Key: 1 Existing water main; 2 Proposed water main; 3 Reservoir; 4 Storage tank



Map No. 25: Gas Supply Key: 1 Refinery gas inlet (import-domestic area);  
2 Holder Station; 3 Super grid (governor) station; 4 Distribution depot; 5 Recompression station;

almost 1,465 million gallons daily. The Board has three possible augmentation schemes which together would yield 5.35 million gallons daily from the Carron Valley, Earls Burn and Birken Burn Reservoir. The total of existing surplus and future resources would amount to 6,815 million gallons daily.

In addition to eight million gallons per day from the Stirling and Falkirk Water Board, Grangemouth has resources of eight million gallons daily (two million from North Thied Reservoir and six million from the First Phase of the Loch Turret Scheme). The present water consumption in the Burgh is approximately 13.5 million gallons a day. The high rate of water consumption is due to the industrial water usage. The present surplus thus amounts to 2.5 million gallons a day. Proposals to develop the second phase of Loch Turret could add a further four million gallons per day and possible future schemes for obtaining an additional eight million gallons a day have also been considered, which would make a total supply of twenty-eight million gallons a day available to the Burgh by 1980. Thus the total of existing surplus and future resources amounts to 14.5 million gallons daily. Estimates made of the future demand within the Burgh show the possible future demand to be between twenty-eight and thirty million gallons a day. A limited unfiltered water supply is also provided for industry within the Burgh.

At Denny, the present water consumption averages about 0.6 million gallons per day. This supply is obtained partly from the Burgh's own Broadside and Overton Reservoirs, and the balance from the Stirling and Falkirk Water Board. At peak demand about a hundred gallons per head per day is consumed, which is very high. The Burgh has no plans for augmenting its own supply of water.

The water supply for Bo'ness is obtained from Lochcote and Cartier Reservoirs yielding 0.6 million gallons per day. The present daily consumption is 0.7 million gallons daily, including that supplied to industrial developments. The Burgh's future augmentation of resources is from the West Lothian Water Board. In their future proposals, the Board have provided for a supply of an additional one million gallons a day to Bo'ness. Therefore, the town's total of existing surplus and future resources amounts to 1.25 million gallons daily.

The total of existing resources and possible augmentations available would amount to some forty-six million gallons a day, while the present total consumption is twenty-four million gallons a day. Therefore, the total overall surplus would be approximately twenty-two million gallons a day as shown in the following Table:

#### *Water Resources, Consumption and future Augmentation of Water Supplies in the Area*

Water Authority	Existing Resources At Source	Bulk Supplies and other com- munications	Net	Present Consump- tion in supply area	Surplus	Future Augmen- tation schemes	Total of existing surplus and future resources
Stirlingshire and Falkirk Water Board	23.165	-12.84	10.325	8.85	1.465	5.35	6.815
Grangemouth	8.0	+ 8.0	16.0	13.5	12.5	2.0	14.5
Denny	0.3	+ 0.3	0.6	0.6	—	—	—
Bo'ness*	0.8	—	0.8	0.70	0.1	1.15	1.25
	32.265	-4.54	27.725	25.66	4.065	18.50	22.565

\* Figures for Bo'ness include supplies given in the present supply area of West Lothian Water Board, and the future augmentation allows for replacement of these from the Board, plus one m.g.d. for further development in the Bo'ness area.

SOURCE: Grangemouth and Falkirk General Services Technical Committee.

Further bulk supplies of potable water could be obtained from the Loch Lomond Scheme.

About four million gallons daily of water for industrial purposes are at present extracted from and returned to the Forth and Clyde Canal. The potential industrial supply for use and return is large, and could rise to eighteen million gallons a day.

#### **Gas Supply**

Gas supplies are administered by the Scottish Gas Board. The manufacture of domestic gas has ceased within the Area and all supplies are imported. Gas produced as a by-product of the Grangemouth Oil Refinery is exported to the Scottish Gas Board manufacturing station at Gretna.

The regional supergrid network, the local high pressure network and ancillary stations are shown on Map No. 25 'Gas Supply'.

Whilst consumption of gas is increasing due to present development, no difficulty is envisaged by the Scottish Gas Board in meeting the current and future demands. The needs of new development can be met by the extension or duplication of the low and medium pressure system, or by the construction of spur lines from the supergrid system. A continuous improvement of the carrying capacity of the existing distribution network is taking place and new works under construction are designed to meet the requirements of high pressure natural gas distribution.

#### **Refuse Disposal**

Six Local Authorities are responsible for the collection and disposal of the various wastes. (See Map No. 26 'Refuse Disposal').

In Falkirk, wastes collected include household and trade refuse, waste paper, food waste, and garden refuse. The weighed tonnes of various classes of refuse collected during the year ending 15 May 1965 are as follows:

Household and trade refuse . . . . .	8,827
Waste Paper . . . . .	656
Food Waste . . . . .	439
Garden Refuse, some . . . . .	1,960
	11,882

The weight of household refuse collected is increasing slightly each year, but the volume, due to the increased use of packaged foodstuffs and tinned goods, is becoming very much greater.



Map No. 28: Refuse Disposal. Key: Collection Areas: 1. Geogamouth. 2. Falkirk. 3. Denny. 4. Bo'ness  
5. Stirling County. 6. W. Lothian Services and Tipping Areas. 7. Depot. 8. Tip in use. 9. Future tip  
10. Coopiered tip. 11. Refuse disposal works.

Falkirk has a mechanical separation and incineration plant, centrally located within the Burgh, which can deal with over eighty tons of refuse per eight-hour day. Full-scale salvage operations are carried out, with an output of over 2,500 tons of materials recovered during 1965. Some trade wastes from Grangemouth are received at this plant on a customer basis. Two tips are at present in use in the Burgh for inedible refuse, covering in total some fifty acres of land. Facilities are also given to civil engineering and building contractors for tipping spoil and it has been suggested that when completed one of the sites might be used as a sports field. The tipping of incinerated refuse has been completed on many other sites, and the Burgh has earmarked some hundred acres to be used as possible future tips which could be ultimately used for residential purposes or as agricultural land. In addition, some refuse is processed for the production of compost. The Burgh's Cleaning Department is responsible for the cleansing of all streets and the clearance of snow.

In Grangemouth, the refuse is transported to a refuse tip at Kinnel Burn. By mid 1965, seven acres of land had been restored and sown with grass. In 1966 the Burgh acquired an extensive area including a large part of the Kinnel Burn. The tipping of waste materials within the whole of this extended area is now strictly controlled and facilities have been extended to include the disposal of industrial wastes, spad from new construction, and refuse from Bo'ness. This has resulted in a more rapid rate of land reclamation and a general improvement in waste disposal. Waste paper is separately stored on the vehicles, and is transported to a depot where it is

baled for disposal to the paper mills. The Burgh provides a mechanically operated street cleaning service.

The Burgh of Bo'ness provides a refuse collection service and a pilot scheme using paper sacks has been introduced. The Burgh is now making use of the disposal facilities provided by the Burgh of Grangemouth.

In Denny, household refuse collected amounts to approximately 1,820 tons while some two hundred tons of waste paper are salvaged annually. For some years suitable tipping sites have been difficult to obtain; the life of the present tip is short and there is a need for an alternative method of disposal.

The Growth Area lies within three Stirling County Districts responsible for scavenging services, where disposal of refuse is by a number of tips situated in various parts of the area. Difficulties in finding suitable refuse tipping sites, particularly in the Larbert District, have caused the County to consider alternative methods of disposal. Negotiations are now in progress for setting up a refuse pulverisation plant to be located near Bonnybridge sewage works which, if needed, will be able to deal with sewage sludge. The Burgh of Denny is anxious to participate in this scheme.

The portion of the Growth Area lying within the hilly area of West Lothian is served from a depot at Bridgend, and refuse is conveyed to a county tip in the same locality.

Despite facilities, which over the years have been provided by Falkirk and most recently by Grangemouth, spoil and industrial wastes continue to be tipped in unauthorised sites causing unnecessary眼害.

## Drainage Facilities

All the communities have drainage facilities, providing both combined and separate systems for sewage and surface water. At Falkirk Burgh there is a combined drainage system for most areas. Practically the whole of the Burgh's built-up area is served by sewers discharging, after treatment, into the River Carron. The main sewage treatment works at Daldense (Falkirk Burgh and Stirlingshire County's Drainage District Committee) has now been completed and discharges into the River Carron. It provides for a population of sixty-five thousand and can be extended to serve eighty thousand. The plant provides full biological treatment and sludge digestion.

Most of Grangemouth's built-up area is drained by a combined system. The Burgh lies on the flat low-lying carselands, between the Rivers Carron and Aven, which has created drainage difficulties generally resolved by extensive pumping. The old town drains directly to the River Carron and pumping is necessary at certain tides to diminish the risk of flooding. The bulk of the town is drained via pumping stations at Grangeburn Road and Zetland Park to Bowhouse Pumping Station, where the foul sewage is pumped to treatment works under construction at Kinnell Kerse, and thence to the tidal waters at the mouth of the River Aven; storm water is pumped direct to the River Aven. Two further pumping stations will be constructed in the old town area and connected with the existing drainage system to the south. The initial design capacity of the new treatment works at Kinnell Kerse is for a population of twenty-five thousand, but land is available for extension as required. The works will include facilities for settlement and sludge dewatering.

At Bo'ness the drainage system is mostly on the combined principle, with the exception of recent development on higher areas. All effluents discharge by gravitation into the River Forth in a raw state at seven outfalls located along the waterfront. The Burgh has plans for the treatment and disposal of both sewage and storm water, and sites for sewage works have been reserved on the foreshore.

Denny and Dunipace have a combined drainage system dealing with both surface and foul water. The existing main drainage is inadequate and a new main sewer network to serve some ten thousand people is under construction. Because of difficulties in levels, pumping will be necessary. The existing method of sewage treatment is obsolete, and plans for a new sewage treatment works on the bank of the River Carron are well advanced. The works are designed for a first stage population of fifteen thousand, with space for expansion to serve a population of more than thirty thousand.

Most of the small communities in the south-eastern area (a combined population of some twenty-nine thousand) are served by drainage and sewage purification works covering small areas. These are often outdated and/or overloaded, and are to be superseded by a comprehensive regional drainage scheme which will collect all sewage from these areas, and convey it to a sewage treatment works to be built at Polmont Hill on the banks of the River Aven. Main sewers have already been laid from Maddiston towards Polmont and from Laurieston to Northfoot where a pumping station will raise sewage to the Polmont Hill works. The scheme envisages a future population of sixty thousand; two-thirds of the sewage will drain to the new sewage works by gravity, and the remainder will be pumped. Wherever possible, surface water in new development will be taken separately to the nearest watercourse.

The Larbert-Stenhousemuir area is divided into two main drainage zones: the high level system includes Stenhousemuir; the low level system generally runs near the Carron River to the Carron-side pumping station. Both networks cross the river and discharge to the Daldense sewage treatment works. At Skinfalls village, sewage will be pumped across the Carron to the Daldense works. Sewage from the village of Airth drains to settlement tanks, the effluent from which discharges into the tidal waters of the Forth.

The Bonnybridge area is drained to the main Bonnywater sewer, leading to the Roushmuir sewage works. This works replaces several small existing works and tanks, and has been designed for a population of fifteen thousand. It gives full biological treatment and sludge digestion. The capacity of the works can be increased by fifty per cent by the addition of further units.

Landward areas to the east are within the County of West Lothian. At Blackness, sewers on the combined system discharge to the Forth above low water mark. The sewers from the Muirhouse area are also on the combined system, discharging below low water mark.

The standard of performance of the existing drainage facilities for both residential and industrial development varies considerably. In most of the communities foul and surface water drainage are still on the combined system, causing inflexibility, treatment problems, and the pollution of watercourses by severe sewage overflows. Some of the main sewers are unable to deal with present flows and require duplication or enlargement. Small inefficient local sewage works, especially in the southern landward areas, provide only limited treatment below acceptable standards, but most of them will be superseded by the new works. Another problem is presented by the discharge by industry of untreated or only partially treated effluent into streams, causing considerable pollution. There is flooding in both rural and built up districts of low lying areas, because of inadequate control of surface water run-off.

The existing, and particularly the proposed drainage schemes, have spare capacity in certain locations. The Daldense Sewage Works and the future sewage works to be built at Polmont Hill, Kinnell Kerse and Denny, can be extended. The total capacity of all drainage works existing and planned would be sufficient for a population of at least two hundred and forty thousand. The existing system is shown on Map No. 27 'Drainage'.

## COMMUNICATIONS

### Existing Road System

The Growth Area lies midway between Glasgow and Edinburgh within the communication network of Central Scotland. The communication network serves both national and regional traffic.

There is an extensive system of classified roads, reflecting the complexity of present traffic movements. There are three main corridors of movement: the A9 trunk road (south-east to north-west via Falkirk); the A80 trunk road (south to north, via Denny); the A876 trunk road (from A80 to Kinneil Bridge). Other A-class roads such as A904 and A905 provide indirect links between the main industrial and residential areas. The remaining classified roads follow no obvious pattern: the B805 and B816 roads radiate from Falkirk and with other link industrial sites and residential areas. Numerous minor roads complete the overall road network, providing links between A and B class roads. (See Map No. 28 'Existing Road System'.)



**Map No. 27: Drainage**

**Key:** Areas served by existing sewers. 1. Swansdown. 2. Felkirk. 3. Denny. 4. Boness. 5. Stirling County. 6. W. Letham. Components of the drainage network: 7. Main sewers. 8. Proposed sewers. 9. Pumping station. 10. Proposed pumping station. 11. Sewerage works. 12. Proposed sewerage works. 13. Sewage outlet (untreated). 14. Stormwater drain. 15. Proposed stormwater drain. 16. Water courses.



**Map No. 28: Existing Road System**

**Key:** 1. A-class roads. 2. B-class roads. 3. Unclassified roads.

## Traffic Generation and Movement

A wide distribution of land-uses generating heavy traffic throughout the Mid-Forth Basin has created a complex network of traffic movements of both passengers and goods. These can be classified into those with both origin and destination within the Area, and those which either originate in, or are destined for it.

Travel-to-work journeys include movements within towns, e.g. Falkirk, where nearly 90% of its employment is drawn from labour living within the Burgh; movements between settlements (almost 3,000 person trips daily between Falkirk and Grangemouth); and movements where residence and/or work place lie outside the main settlements. Journeys also occur between residential areas and shopping and recreational facilities. These journeys create major traffic flows, particularly in an east-west direction.

In 1964 "in-commuting" journeys amounted to 3,460 person trips daily whilst the "out-commuting" journeys amounted to 4,170. Journeys within the area can be classified into short and long distance according to whether these were within one labour exchange area or between labour exchange areas. Long distance journeys were in the order of 5,000 p.e.u.s. in 1964 and short distance journeys were higher.

Grangemouth attracts the greatest number of workers from beyond its boundaries, extending to Glasgow and Edinburgh, and traffic is intense along the three A class roads entering the Burgh.

Traffic flows, generated by commerce and industry, are particularly heavy at Falkirk. A recent survey showed some 19,000 vehicles per sixteen hour day entering the Burgh each working day along the seven main classified radials focusing on its central districts. Falkirk's town centre has a catchment extending beyond the limits of the Area. In recent years the increasing movements have resulted in severe congestion during peak hours, especially in and around the industrial zones and central area.

**Falkirk:** At Falkirk, during the period 1952-65, traffic increased in some places by over thirty per cent. A census showed that over thirty per cent of the traffic entering the Burgh is by-passable. Most of this traffic passes through the town centre. A major factor increasing congestion in Falkirk is the nature of the traffic which is very mixed. The 1964 census has shown that for a normal working day, over thirty-two per cent of the total traffic flows using the Burgh's main road system consists of heavy goods vehicles and buses, compared with a national figure of seventeen per cent.

Traffic in the town centre presents a major planning problem. The 1964 census has shown that some fifty per cent of the traffic entering the centre wishes to stop there. This presents a major parking problem, as there are facilities for only two-thirds of the demand. The problem is aggravated by vehicles servicing shopping and commercial premises, and by a daily flow of 740 public service vehicles. Other sub-centres within the Burgh attract considerable traffic and twenty-four per cent of all stopping traffic has its destination in these zones.

**Grangemouth:** The main traffic problems in the Burgh result from heavy peak commuter flows and industrial traffic which are heaviest on the A904 road. The road system does not provide a satisfactory outlet for the heavy traffic generated by the docks and industries, which have to use residential roads. The many access points from industrial premises located along the main roads create a potential cause of accidents and delay.

**Other Settlements:** The traffic problems of these smaller settlements emerge from the increased use of the motor vehicle for the transport of both people and goods, simultaneously catering for different types of traffic requiring various road standards. A common problem is the use of residential distributors as industrial feeders; the presence of through traffic in urban areas; the lack of parking facilities, and the lack of rear access for servicing shops and commercial premises. Accessibility between, and within towns, has consequently decreased, and at the same time the continued growth of traffic has combined to increase danger, noise and pollution causing severe deterioration in the urban environment.

## Port and Canal System

### Waterways

The history of the waterway system, comprising the Forth and Clyde and Union Canals and the Rivers Carron and Avon, is linked with the Port of Grangemouth's expansion, and helped in building up the Port. The Canals, together with the Monkland Canal, formed a network crossing Scotland from east to west, and linking Edinburgh with the industrial areas round Glasgow. The River Carron provided a valuable link between the Iron Works at Falkirk and the Port, and still provides access to the docks. A boat-building industry was set up on the river bank which today is still flourishing. The waterway system, in addition to its historical association, is a thriving area for wild life, and could become an important scenic and recreational asset.

### Port of Grangemouth

The Port of Grangemouth provides a favourable location for the collection and distribution of goods within the Central Scotland Industrial Belt and handles a considerable volume of imports and exports. It lies some four miles from Falkirk's town centre, just over ten miles from Cumbernauld and Livingston New Towns, and less than thirty miles from Glasgow, Edinburgh and Perth. The Port offers extensive dock facilities closely related to a major industrial complex, largely formed by chemical and petro-chemical industries. It comprises four wet-docks with modern berths, two dry docks and repairing facilities, and can accommodate dry cargo vessels of up to 10,000-11,000 tons (see also Volume One, Chapter 6, 'Transport', and Map No. 29 Port).

Grangemouth is the busiest port in Scotland after Glasgow. Goods handled include coal, iron ore, iron and steel products, building materials and general cargo. It is the main distributing centre for oil and the principal timber importing centre in Scotland. Frequent services operate to and from Western Europe and Scandinavia. In 1965, the total shipping tonnage handled amounted to 4,371,770 tons. Of the total 3,046,504 tons were petroleum products. Imports amounted to 1,682,333 tons (thirty-eight per cent of the total tonnage), fifty per cent of which were petroleum products and thirteen per cent timber. Exports totalled 2,689,437 tons (sixty-two per cent of the total) eighty-two per cent of which were petroleum products. Almost seventy per cent of the total shipping tonnage was handled by pipeline. Sixty per cent of the remaining cargo to and from the Port was carried by road and forty per cent by rail.

In 1962 the "Report of the Committee of Enquiry into the Major Ports of Great Britain", Chairman Lord Rochdale, framed the policy for the development of the Firth of Forth ports, including Grangemouth. The Port suffers from inadequate facilities



Map No. 28: Port. Key: 1. Eastern Channel. 2. Grange Dock. 3. Western Channel. 4. Cavan Dock. 5. Old Dock. 6. Jardine Dock. 7. Timber Basin.



Map No. 29: Proposed Dock Improvements  
Key: 1. Half-mile of approach channel to be deepened.  
2. New dock 800' D' x 100' D' wide x 24' 8" draft.  
3. Two larger berths for vessels of 35,000 tons D.W. (max. 70,000 tons D.W.).  
4. Fully loaded tankers for maximum 25,000 tons D.W.  
5. About 2,700' D' of quays for dry cargo ships and bulk carriers up to 25,000 tons D.W.  
6. 500' D' long deep water quay for dry cargo bulk carriers up to 60,000 tons D.W., berths realigned 20 acres.

and obsolete equipment which hampers further development. Its limitations prevent large cargoes being received, and this situation will continue until longer berths, greater depth of water and wider docks are provided. Road access to the Port needs major improvements. (See Map No. 30 'Proposed Dock Improvements').

#### Rail Facilities

##### Existing Services

Two main lines of national significance traverse the Area, the Edinburgh-Glasgow line via Falkirk (High) Station, and the Glasgow-Sunderland line via

Larbert Station. Other lines, both passenger and freight, form a complex network linking the main towns, the docks and the major industrial zones. There are also a number of small branch lines, mineral lines and innumerable sidings serving foundries, collieries and factories. (See Map No. 31 'Railways').

The total number of trains stopping at stations including local and through services, is given in Table 1 below and Map No. 32 'Rail-Passenger Power'.

TABLE 1

Number of Trains Stopping at Stations over One Week Period  
(9th-16th May 1965)

Larbert Station	656 stops
Falkirk (Grangemouth) Station	539 stops
Polmont Station	438 stops
Falkirk (High) Station	236 stops
Graingerworth Station	230 stops
Falkirk (Cadder) Station	197 stops
Greenhill Station	123 stops
Bonnybridge (High) Station	35 stops
Stations at Denny and Bo'ness have been closed.	

SOURCE: British Railways Timetable.

#### Reshaping of British Railways

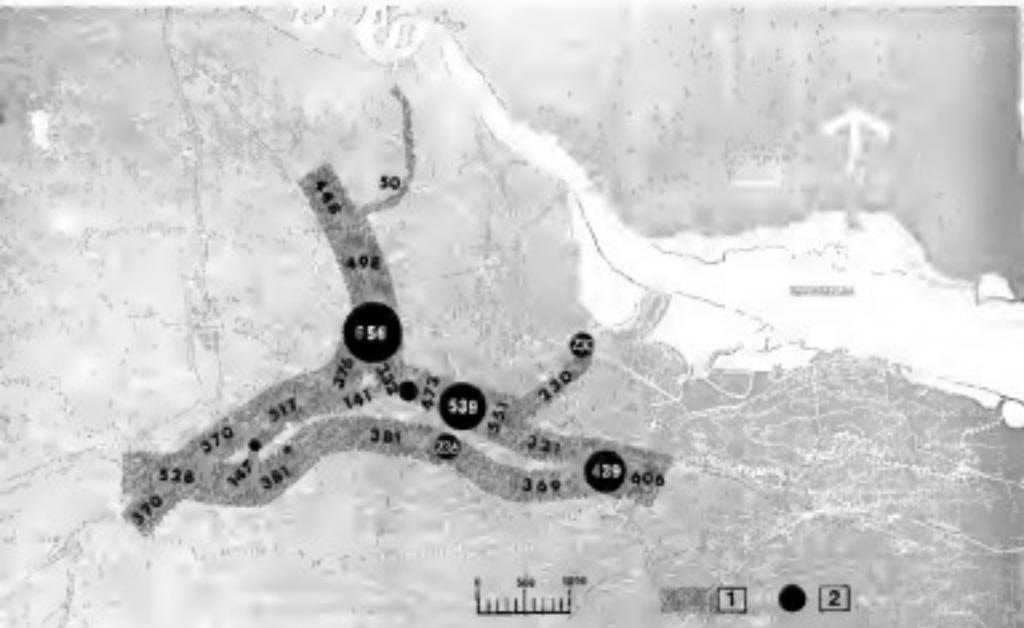
These sections of Dr. Beeching's Report "The Reshaping of British Railways" which affect the Area, can be summarised as follows:  
Between Edinburgh and Glasgow: concentration along the Edinburgh/Falkirk (High)/Glasgow line. This route is the only one of these lines linking Edinburgh and Glasgow which will be improved.  
From London and Cambridge to the North: concentration along the Cumbernauld/Larbert/Stirling line.  
Between Edinburgh and the North-west: served by an improved Edinburgh/Larbert/Stirling line.

Some passenger stations are recommended for closure.



Abc 1 ABC 2 — 3 — 4 — 5 — 6 — 7

**Map No. 33: Railways** Key: 1. Station ~~now~~ awaiting closure 2. Station to remain open 3. Stopping passenger services to be withdrawn 4. Track or infrastructure loss 5. Passenger/secondary services 6. Freight/railway services 7. Railway station location



After 8 hr., the R-10X, Resonator Elbow (for the next 5-15 min., 1960). Count 3. Red intensity. 2. Studio calling intensity.

Existing freight services are virtually unaffected. Private sidings and goods traffic will depend on demand. British Railways will provide connections, and trains, if suitable train loads see forthcoming. There are extensive goods depots at Grangemouth and Bo'ness which could handle additional traffic. (The former depot deals with the majority of goods as part of the Port complex.) Reference should also be made to Volume One, Chapter 6 'Transport'.

### Air Transport

The Area's needs for air transport are provided for by three airports located at Prestwick and Aboyne near Glasgow, and Turnhouse near Edinburgh. These provide local, national and international services.

Numerous local runways suitable for light aircraft used by business executives are located throughout Central Scotland. The nearest air strip is at Cumbernauld New Town.

## PLANNING IMPLICATIONS

### Infrastructure

#### Electricity Supply

There is sufficient electrical energy available to prevent any restriction on population growth.

Limitations to development will occur along the route of the Super Grid Transmission System and building will be restricted on land below and adjacent to all overhead cables, due to the necessary statutory clearances.

The environment will be directly influenced by the grid system, in particular the 400 kV pylon, affecting rural and urban amenities.

#### Water Supply

There are ample supplies of water as well as suitable sources for augmentation so that there is no restriction to development.

Grangemouth, with a potential surplus of over fifteen million gallons per day and extra supplies of unfiltered water, is in a particularly favourable position to promote further growth.

The Firth and Clyde Canal has a potential of eighteen million gallons per day of non-potable water for use and return which could attract large water users.

The present system of supply and distribution could cause artificial restriction to development in peripheral areas. These problems would be overcome by adoption of the regional bodies proposed by the Scottish Water Advisory Committee.

#### Gas Supply

There is sufficient provision of gas to meet present and future demands. The rengrid could be extended to meet an unusually high point of demand.

#### Refuse Disposal

Standardised machinery and rationalised methods of refuse collection need to be adopted to replace the piecemeal existing system.

Controlled tipping requires to be enforced to prevent eyecasts, caused by the disposal of crude refuse.

The large quantity of domestic and industrial wastes needs to be pre-treated and directed towards

creative land rehabilitation and regeneration, for which there is ample scope.

Completed tipping sites should be converted into attractive open space for recreation or other purposes, particularly when located in close proximity to built up areas.

High standard treatment plants, able to meet the great variety of domestic wastes and increased volume of industrial wastes require to be provided. The plants should be strategically located, provided with good accessibility and close to the sewage treatment works, thus facilitating the production of composting.

Mutual aid schemes for the disposal of wastes between local authorities should be encouraged. In fact, all tipping operations should be co-ordinated in order to increase the efficiency of the land rehabilitation programme.

#### Drainage Facilities

Future development should be influenced by integration of existing drainage networks, ignoring limitations imposed by local authority boundaries.

Maximum use should be made of existing sewer networks so that the location of existing network sewers below capacity should be considered for the siting of future development.

Pond and surface water drainage should be provided in separate systems. Surface water drainage systems should make full use of the various watercourses.

Proposed new sewerage works should be quickly implemented to replace overloaded and outdated systems and eliminate the discharge of uncontrolled effluents into the river.

The removal of sludge from the sewage treatment works should depend upon co-ordination with the refuse disposal service for composting purposes, and upon the rehabilitation and recreation programmes.

Flooding in low lying built up areas should be prevented.

## Communications

### Road System

Road connections between the east (Grangemouth and Bo'ness) and the west (Denny) are devised and more direct routes should be built. To eliminate present peak hour traffic congestion, major road developments should be carried out in the central sections linking Falkirk to Grangemouth, Bo'ness and Denny.

A new inner circular system for Falkirk's Town Centre traffic movements should receive priority to allow for peak weekend shopping flows. Major parking facilities should be provided at Falkirk's Town Centre.

Adequate parking facilities should be provided at all major district centres, particularly where existing shopping centres are to be retained.

A main traffic priority should be the diversion of east-west through traffic.

Due to the high number of public transport vehicles pausing and stopping at Falkirk's Town Centre, bus stops should have improved lay-bys and a bus station should be provided, directly connected to the Town Centre's inner road network.

In Grangemouth's inner districts, major east-west flows should be redirected away from main residential clusters with housing frontages.

Heavy industrial traffic to Grangemouth's industrial complex should be encouraged to by-pass major built-up areas, in particular the outer residential areas of Grangemouth, Falkirk, the Larbert area, Larbert and Bo'ness.

Heavy goods vehicles and haulage transport entering Grangemouth dock areas should have direct access, separated from other traffic.

Major roads should be designed to enable maximum vehicular-pedestrian segregation. The broken topography should make some vertical separation possible.

#### Port and Canal System

In view of the importance of the Port of Grangemouth and its rate of increase in tonnage handled, the 115 acres of undeveloped land within the port area should be safeguarded for proposed future dock improvements.

Because of the unique location of the port within Central Scotland, incentives for attracting water-bound industries needing close port facilities should be provided. Those industries using petroleum products and timber should be especially encouraged.

Improved road accessibility to the docks should be provided as a main priority.

The canals already provide substantial quantities of water for industrial purposes, and further abstraction should be encouraged.

Proposals for specific recreational activities should be encouraged in those sections of the Forth and Clyde and the Union Canals which are of high scenic value. Both waterways could well form part of a recreational and pedestrian network, encouraging such activities as boating and fishing.

#### Rail Facilities

The withdrawal of some suburban services will affect accessibility between settlements and employment areas, and alternative means of public transport will be required.

The proposed improvement in rail services and the establishment of freight centres should significantly contribute to the advantages of locating industries.

For general goods, the Grangemouth Depot provides a useful service, but when the proposed liner trains are fully developed, a case could be made for a centralised depot near Falkirk, which lies on the direct north, east and west lines and provides fast, and frequent services to the main centres of Glasgow and Edinburgh.

#### Air Transport

Improved maintenance facilities for light executive type aircraft at the various local runways now in existence near the Growth Area would prove an attractive incentive to private industry requiring that efficient and flexible means of air communication.

Improved facilities, particularly at Turnhouse Airport, would benefit the Area. Further facilities for light aircraft using the present runways or provision of new runways would be attractive to industry.

Improved road accessibility should be provided between industrial sites and the major airports (particularly Turnhouse).

## 4. Growth Potential (First sieve)

### INDUSTRY

Of all the land uses in the Growth Area, industry is the most vital to its successful overall development, overriding the claims of all other land users. Since it is the generator of urban development, whose needs will more and more dictate the policy of urbanisation; and since its requirements are relatively inflexible, the survey and analytical studies were carried out with the utmost care to determine its best location in the Area. The main consideration was the location of heavy manufacturing industry, since the criteria for the location of light industry are less stringent and more in line with those of residential areas.

The various factors which were identified as being relevant, and then assigned to their proper class, are as follows:

#### Analyses

##### Natural Factors

These factors are shown on Map No. 33 ("Industry I. Natural features affecting the location of industry").

Slopes 1:60-1:12

Water

Pearl Bogs

Dedicated woodland or afforestation

and on Map No. 35 ("Industry III. Urban land use affecting the location of industry").

Existing residential built-up areas

Existing industrial built-up areas

Public open space

Railways

Water

##### Modifiable Limitations

These factors are shown on Map No. 33 ("Industry I. Natural features affecting the location of industry")

Slopes 1:60-1:12

Sed fertility A and A+

Areas partly wooded and shelterbelts

Land with high water table or possible flooding

Land with limited bearing capacity

##### Positive Factors

These factors are shown on Map No. 34 ("Industry II. Accessibility affecting the location of industry"). More important industrial activities are usually heavily tied by certain factors which determine their location. These include the location of raw materials; the accessibility to lines of communication and transport; and, as in the case of our industrial site in the Growth Area, access to the open water and proximity to the docks. Since the existing industries largely exploit all natural resources, the "tying" factor of accessibility is considered the most important positive factor, creating optimum values for industrial location in the following areas:

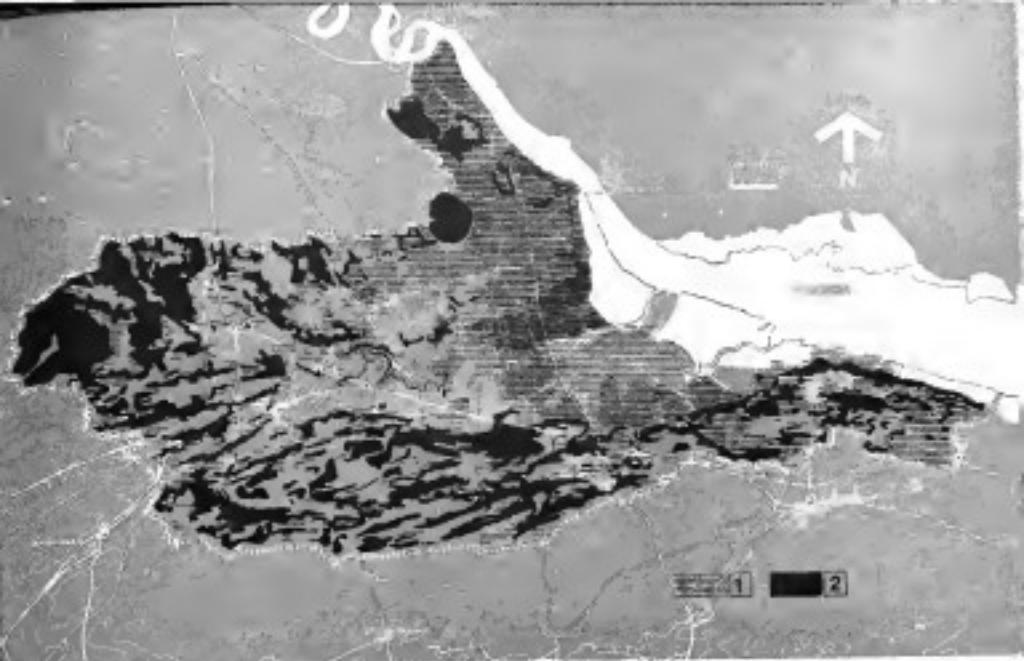
Areas within a one mile radius of a railway intersecting giving access to the Growth Area

Areas within a one mile radius of a main nation, or within five hundred yards of a railway line

Areas within one-third of a mile distance on both sides of A-class roads and within one quarter of a mile distance on both sides of B-class roads

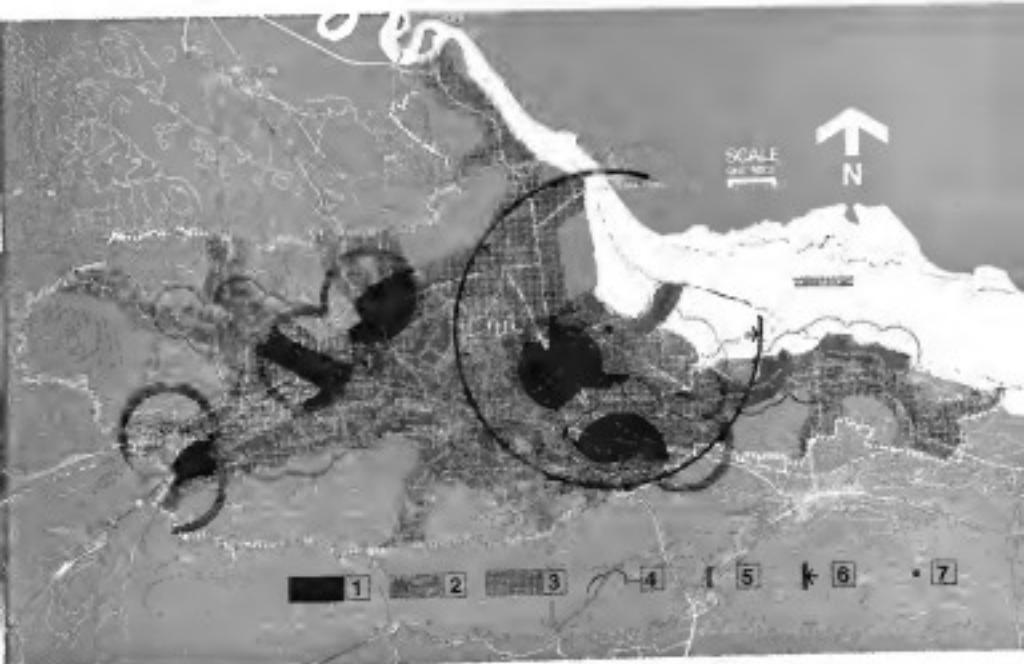
Areas within half mile radius of existing industry

Areas within a three mile radius of the port



*Map No. 33: Industry I—Natural features affecting location of industry*

*Key: 1. Modifiable features 2. Negative factors.*



*Map No. 34: Industry II—Accessibility affecting location of industry*

*Key: 1. Optimum accessibility, 2. Very good accessibility, 3. Good accessibility, 4. Delimitation of areas within half-mile radius of existing industries, 5. Delimitation of areas within one mile radius of railway intersections, 6. Delimitation of areas within three-mile radius of access to the port, 7. Access to the port*



**Map No. 38: Industry IV—Urban land area affecting location of industry**

Key: Negative Factors: 1. Existing Residential Built-up Areas. 2. Existing Industrial Built-up Areas.  
3. Public Open Space. 4. Railway Areas.

### Synthesis

The integration of these partial analyses built up a workable synthesis defining the degrees of suitability of land for industrial location within the Area based on simple mathematical calculations. Within the analysis of accessibility these main groups were distinguished (see Map No. 34, "Industry II. Accessibility affecting the location of industry").

Areas with easy access to main railway intersections, to railway lines and to A-class roads, were designated by the figure +5 for further calculations.

The other two groups affected by only one or two positive factors were designated by the figures +2 and +1.

In that analysis most of the areas affected by negative factors either of natural features or of existing land uses were eliminated from further investigations. The following degrees of suitability of land for industrial development from these viewpoints were then defined:

Bad areas (i.e. those not affected by any kind of modifiable limitations), designated by the figure 0.

Good areas (i.e. those affected by one modifiable factor), designated by the figure -1.

Less suitable areas (i.e. those affected by two or more modifiable limitations), designated by the figure -2.

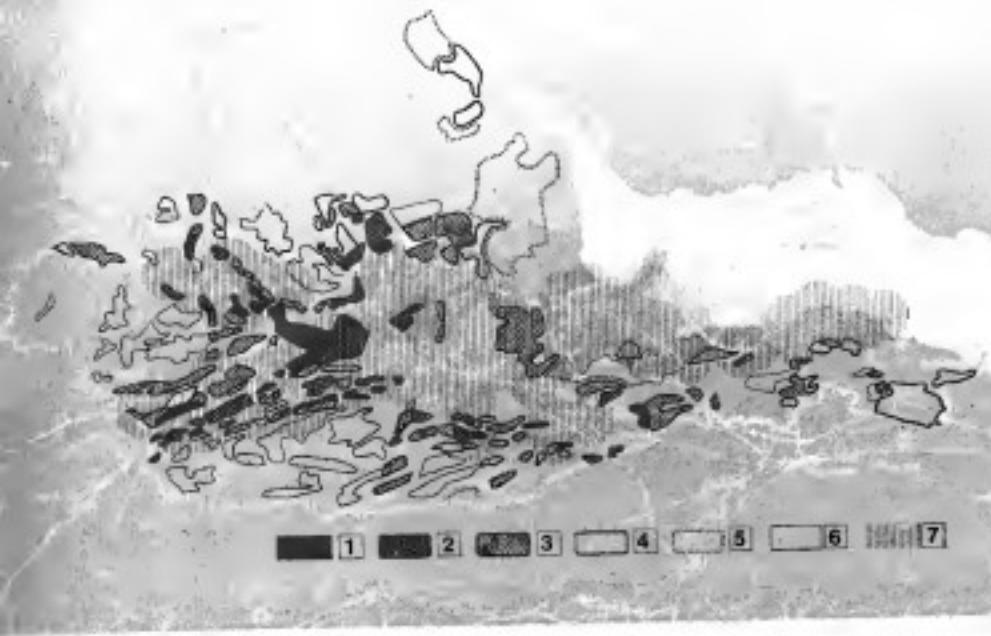
The results of these partial syntheses were superimposed on Map No. 34, "Industry II. Accessibility affecting the location of industry", to obtain six types of areas, all affected by various combinations of positive factors and modifiable limitations (see Map No. 36, "Industry IV. Classification of land for the location of industry"). The best areas for industrial location are those which are not affected by any

negative factors or modifiable limitations and have optimum accessibility, followed by a succession of less suitable sites, down to those which are least suitable but still possible for industrial location.

### Conclusions

The most important results obtained by this investigation were the revelation of possibilities for the further development of existing industrial sites round Grangemouth port, and for the location of a substantial amount of new industry round Bonnybridge, which has many areas suitable for various types of industry, although the topography suggests that smaller scale industries are most feasible. This fact might greatly help to balance the location of industry in the Area, one of the prime objectives of the overall urban policy. The direct link of the latter area's location with Cambusbould, which suffers from a lack of suitable industrial sites for further development, enhances this new industrial potential. In addition, a number of more scattered areas throughout the Growth Area were shown to be suitable, and would create good opportunities for the proper distribution of some small complementary industries (both manufacturing and service) directly connected with the more important urban communities.

The analysis was based on existing conditions. New traffic system proposals, however, were later superimposed on the first partial synthesis (i.e. indicating the degree of suitability of undeveloped land for industry from the angle of natural features), and this has revealed new possibilities for industrial development. These possibilities will increase considerably during the period of implementation of the urbanisation policies formulated for the Growth Area by the Structure Plan.



Map No. 38: Industry IV—Classification of Land for Location of Industry

Key: 1. Class A (land affected by positive factors with optimum accessibility). 2. Class B (land affected by modifiable limitations with optimum accessibility or by positive factors with very good accessibility). 3. Class C (land affected by two modifiable limitations with optimum accessibility, or by one modifiable limitation with very good accessibility, or by positive factors with good accessibility). 4. Class D (land affected by two modifiable limitations with very good accessibility or by one modifiable limitation with good accessibility). 5. Class E (land affected by two modifiable limitations with good accessibility). 6. Class F (land affected by positive factors with bad accessibility). 7. Areas within half-mile radius of existing industries.

## RESIDENTIAL AND ANCILLARY USES

Until recently, the criteria on which the suitability of land for housing has been judged have probably been the least stringent of all the land uses. This study set out to investigate the suitability for residential and ancillary functions of land at present undeveloped and mainly agricultural. Areas considered for mostly outside parish boundaries or built-up areas, but agricultural land within these boundaries and not yet zoned in Development Plans was also included. It also attempted to ensure that the evolving environment would meet more exacting requirements than had previously been recognised.

From survey information on the existing residential districts it was noted that in a few years' time not many would be likely to fulfil the desired environmental conditions. Residential environment is largely influenced by detailed design and layout, and access to community facilities; and may be impaired by the effects of poor climate or adjacent noxious land uses. The importance of recognising factors which may influence the residential environment is thus obvious in the process of site selection.

### Analysis

Certain standards to evaluate suitability were laid down relating to the physical structure of the site. These included micro-climate; influence of adjacent land uses; plot zoning activities; and factors which might prevent or affect development such as mineral rights and special areas for conservation.

### Negative Factors

These factors are shown on Map No. 37 ("Residential I. Negative Factors").

#### Water

##### Poor Bog

Land with high water table

Land above 650 feet

Slope steeper than 1:6

North facing slopes 1:6 to 1:12

Climatically exposed areas (defined from landscape studies and indicating altitude/lack of trees/steepness)

Dedicated woodland or afforestation

Areas of exceptional biotic, scientific or architectural value

Existing built-up areas

Land zoned for development by infrastructure routes (public utilities or transport network):

motorways: 150 feet either side

electricity O/H cables (400 KV, 275 KV,

172 KV,) 50-75 ft. either side

railways: 100 feet either side

gas, water, oil mains: 6 feet-10 feet either side

Land zoned for residential development within Protective Zones (i.e. within zones involving certain motion or undesirable neighbours).

Industry (by classification, radius 50-100 yards)



*Map No. 37: Residential I—Negative Factors*

*Key: 1. Expansion level (marked by 650' contour). 2. High water table. 3. Protective zones (near nuclear industries). 4. Infrastructure. 5. Other negative factors.*

institutions; mental—100 yards radius from boundaries; prisons and borstals—½ mile radius from boundary  
sewage works: 100 yards radius

#### *Modifiable Limitations*

These factors are shown on Map No. 39 ("Residential III. Modifiable Limitations").

Woodland and shelterbelts (to be retained if possible for amenity value)

A+ and A class agricultural land

Areas of limited bearing capacity (i.e. calcareous or where boulder clay or gravel is underlain by softer deposits)

Coal workings and sets of abandoned mine workings of unknown extent

Proposed areas of coal extraction (i.e. liable to future subsidence)

Areas of fireclay extraction rights (i.e. liable to future subsidence)

Areas of sand and gravel extraction rights

Tips, bings, derelict sand and gravel workings and stone quarries

Land liable to flood if subsidence takes place after coal extraction

#### *Positive Factors*

These factors are shown on Map No. 36 ("Residential II. Positive Factors").

South and west facing slopes with a gradient between 1:6 and 1:20

Areas with views (long, short or panoramic)

Areas of high quality landscape (i.e. sloping, fertile/wooded; flat/fertile/wooded; sloping/poor/wooded).

#### *Synthesis*

These sets of factors were then sieved to define the areas of graded suitability.

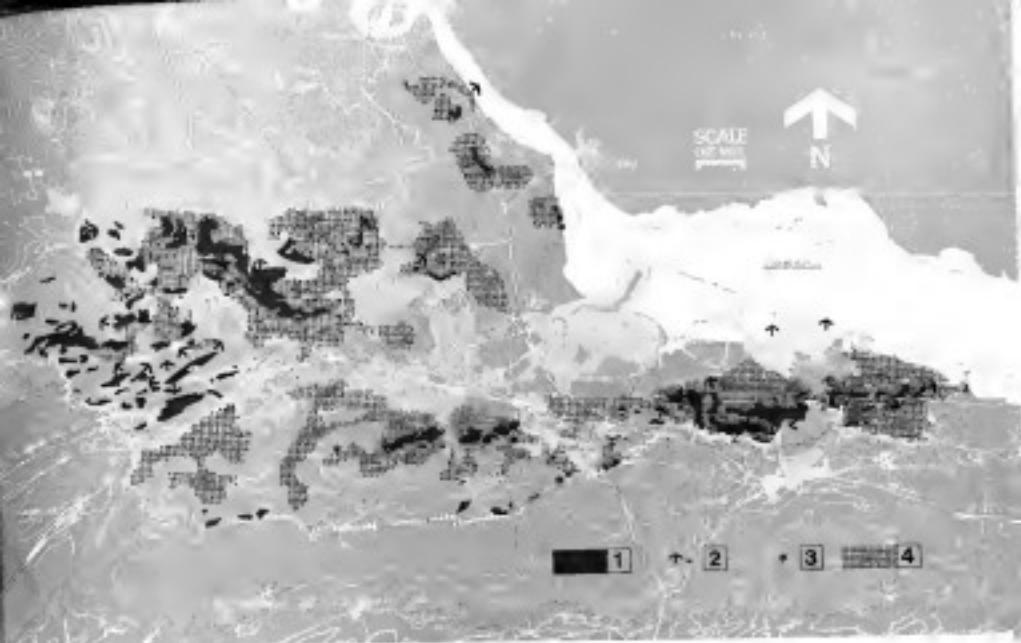
The Map No. 40 ("Residential IV. Synthesis") shows all the parts of the Growth Area which are suitable for residential development. These have been classified into four groups.

The best areas which are immediately suitable for residential development were found by sieving out all the negative and modifiable factors, and then selecting the most desirable sites from the remaining area. These are mainly located north-east of Denny, south of Bo'ness, and south of Falkirk. The second best areas are also immediately suitable for development, i.e. bearing neither negative factors nor modifiable limitations, but lacking positive advantages. These areas are east of Bonnybridge and north of Falkirk. The third best areas are those with modifiable limitations, and also possessing positive advantages. These areas are north-east of Larbert/Strathaven, south of Bo'ness, and around Airth. The fourth group contains the remainder of the areas which are suitable for residential development; they have modifiable limitations and no positive advantages. These areas are north of Skelmorlie and around South Ailes.

#### *Conclusions*

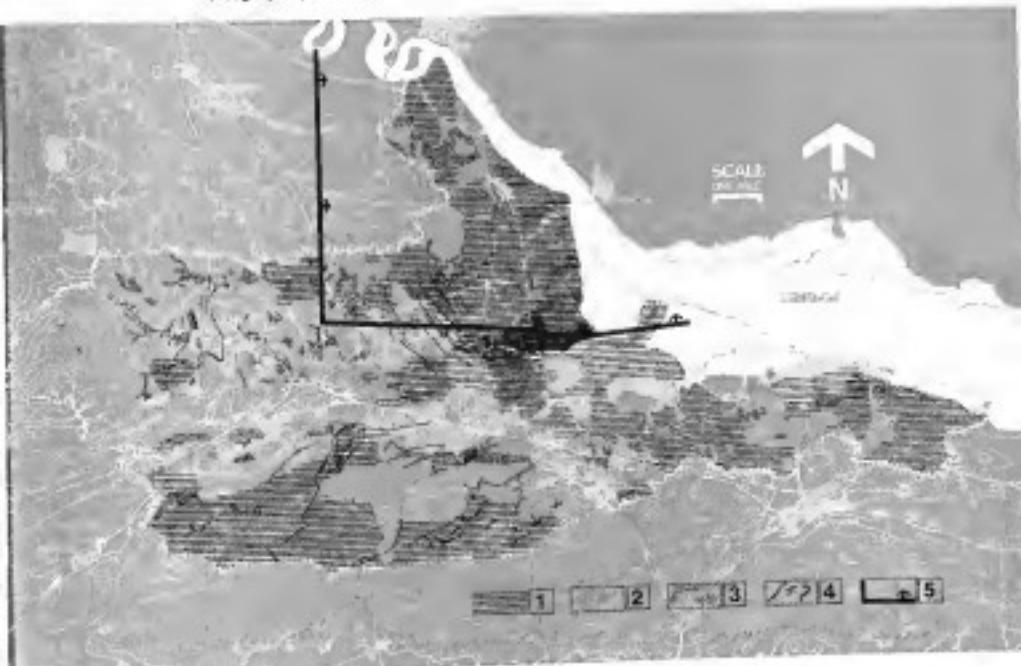
The importance of access, utility services, journeys to work, shopping, etc. for potential residential areas were not considered to be a crucial factor, since the residential and ancillary development will require a new infrastructure pattern in any case and the present situation will need re appraisal and improvement.

All these areas shown to be suitable for residential and ancillary uses will allow a wide choice of sites for development. Although sites adjacent to the existing built-up areas will be obviously ripe for development, the designation of all new residential areas will be decided by the new overall urban structure and therefore influenced not only by physical suitability but also by development objectives.



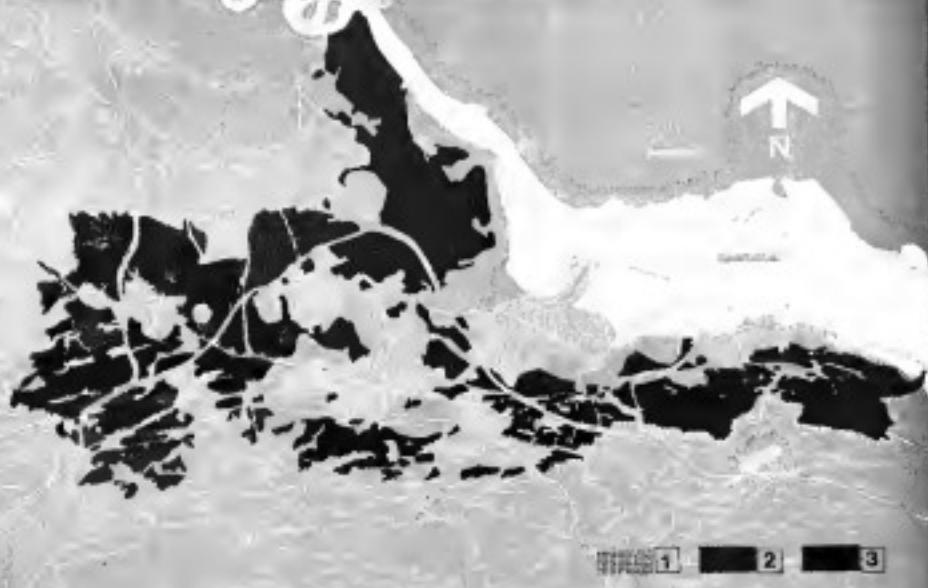
Map No. 38: Residential N—Positive Factors

Key: 1. Slopes south- and west-facing 1:6-1:20. 2. Long and short views. 3. Panoramic viewpoint.  
4. High quality landscape.



Map No. 39: Residential M—Modifiable Limitations

Key: 1. Various modifiable limitations. 2. Tubs, Rungs, Direct Sand and Gravel Workings and Stone Quarries.  
3. Woodland and Shelterbelts. 4. Con/estrape. 5. Proposed areas of coal extraction.



Map No. 40: Residential IV—Synthesis

Key: 1. Most attractive areas for housing 2. Areas available for development after improvement or negotiation.  
3. Areas immediately suitable for development.

## AGRICULTURE

Agriculture shares with the first human settlements the distinction of being the oldest established land-use in the Area. It can be said that, with a few exceptions like estuarine reclamation, most development takes place at the expense of some type of agriculture. Within this context, growth potential studies for agriculture were essentially directed towards the selection of areas which have a significant potential for improvement.

### Analysis

#### Negative Factors

- The urban areas, including industry
- Hospitals and institutions
- Private estates of a non-agricultural character
- Golf courses
- Woodland
- Roads and railways
- Water
- Deep peat
- Rock
- Steep slopes

#### Modifiable Limitations

- The soils of B, B minus and C quality
- The soils of D quality in areas of favourable climate
- Slope and orientation
- Land liable to flood
- Mud flats
- Waste and derelict land; abandoned gravel pits

#### Positive Factors

- A plus, A and B plus quality soils

All the above factors are shown on Map No. 41 ("Agriculture").

### Synthesis

The analysis showed that the greatest potential for improvement was to be found on the mud flats near sea level; on the higher parts of the Area; on the edge of the Slomanian Plateau; and on the rising ground west of Denny. It was also apparent that future urban development must inevitably be at the expense of agricultural land.

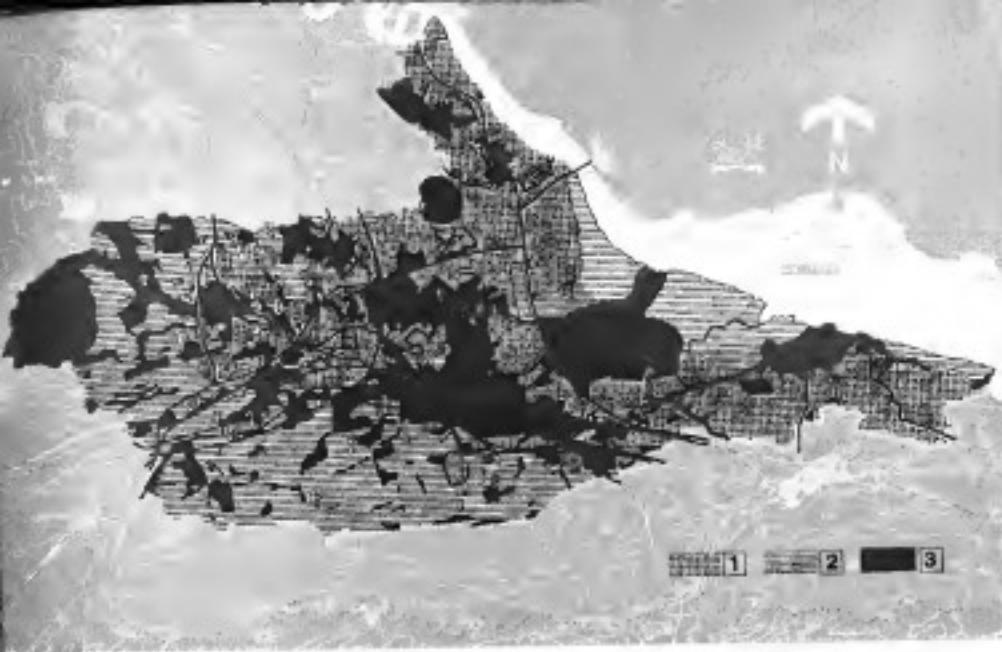
From the analysis, and a knowledge of climatic and soil conditions, it is obvious that there is scope for the systematic improvement of large tracts of ground in this Area. Such schemes, however, will call for further integrated forms of analysis and implementation, particularly concerning drainage and improvement, and tree planting.

### Conclusions

It may be argued that if this growth potential is realistic, it would already have been realised. It is perhaps only the unique combination of factors inherent in a Growth Area that can justify this form and scale of agricultural development. Not only will enormous amounts of refine be available for disposal on reclamation schemes, but the improvement of the rural environment round a densely populated area has also to be considered. New techniques of soil and climatic improvement and agricultural methods may even make it a viable financial possibility.

## FORESTRY

There is an element of competition between forestry and agriculture, while both share the quality of being complementary to certain forms of recreation. In the early ages of human settlement, it was woodland which gave way to the expansion of agriculture; nowadays the process is being reversed.



Map No. 41: Agriculture  
Key: 1. Positive factors. 2. Modified land uses. 3. Negative factors.

This study has not attempted to precisely define where the one should end, and the other begin. In areas where such a decision is necessary a more detailed analysis is needed than a regional study will allow.

#### *Analysis*

##### *Negative Factors*

- The urban area, including industry
- Institutions and hospitals
- Roads and railways
- Overhead cables
- Water
- A plus, A, B plus and B quality agricultural soils

##### *Modified Land Uses*

- Pest
- Mud flats
- Land liable to flood
- Waste and desert land
- Some C and D quality agricultural soils

##### *Positive Factors*

- Areas of existing woodland
- Some B minus quality soils
- All the above factors are shown on Map No. 42 ("Forestry").

##### *Synthesis*

The areas of greatest potential for forestry coincide to a great degree with those of agriculture. Only on the most productive soils is there no use.

A policy of forestry expansion would have to be justified by further detailed soil and climatic studies, and by financial analysis. It is, however, clear that there is great scope for tree planting in future amenity open spaces, and in those areas of severe exposure and marginal quality land.

#### *Conclusions*

Tree planting should be complementary to agriculture, and an integral part of all land rehabilitation schemes. Whether the planting of woodland is undertaken by the Forestry Commission or a Local Authority, it should be planned not only for economic considerations but for the general improvement of the area and, where possible, the extension of recreational open space.

#### *RECREATION*

This study was principally concerned with the potential for recreational purposes of land features mainly outside the urban area. In selecting the criteria on which the factors were based, consideration was given not only to certain traditional forms of recreation, but also to the changing pattern of free time activities, which put more emphasis on mobility, and the use of the countryside. It also attempted to analyse the Growth Areas as one unit, related to its neighbouring regions, and to provide the basis of choice on which to design a coherent regional recreation system.

#### *Analysis*

##### *Negative Factors*

- The urban area, including industry, institutions, hospitals, roads, railways

##### *Modified Land Uses*

- Agricultural land, woodland and private estates
- Buildings of architectural and historic interest
- Reservoirs, rivers and streams
- Deserted and waste land, bings, tips, abandoned grass pits, sand pits
- School playgrounds
- Pest



Parts of the Roman Wall under guardianship or scheduled, or so proposed by the Ministry of Works

Sloping slopes of river valleys and raised beaches

Areas of natural interest at Letham Moss, the Aven gorge, Torwood and Canticary Woods

#### Positive Factors

The coast (except at Greenisland)

The Union and Forth/Clyde Canals

The Forth Estuary

Golf courses

Public open space

Parts of the Roman Wall under guardianship or scheduled, or so proposed by the Ministry of Works

All the above factors are shown on Map No. 43 ("Recreation"). Many areas are already open to the public, although parts of the Canal system and the Roman Wall are not at present suitable for full use because of disrepair of pathways and the overgrowth of vegetation.

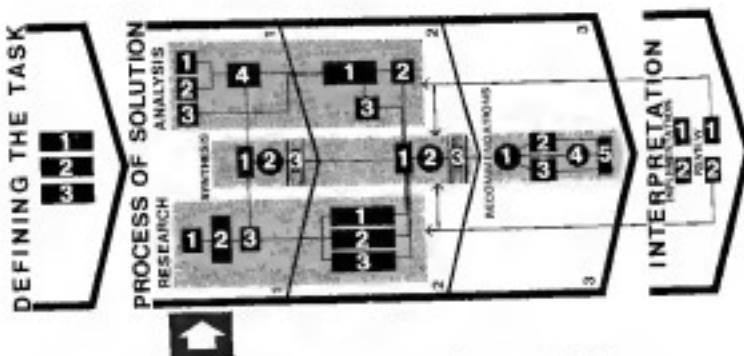
#### Synthesis

In view of the fact that recreation includes such a very wide range of diverse activities, within many different surroundings, the synthesis covered the widest possible range of environments. The analysis showed that a very large proportion of the Area had a potential for some form of recreation, either directly, as in the case of sailing on the Firth; or indirectly, when parts of the countryside had scenic qualities which made them worth visiting. This synthesis formed the basis for the major proposals shown on Map No. 42 ("Recreation").

#### Conclusions

The development of recreational facilities is to some extent linked with the conservation and development of woodland and agricultural areas. The presence of possible lines of pedestrian access through these areas (such as the Roman Wall, and the Canals) makes this form of development particularly attractive. There are also large areas of relatively poor agricultural ground of low sonic value, south and west of Falkirk, which appear to have great potential for improvement, and multi-use reservoir — agriculture — forestry development, while the hillier areas round Dennydale have already scenic qualities which should make them attractive for outdoor recreation.





## Research Studies: Possible Development Patterns

### 1. MODEL RESEARCH PROCESS AND PLANNING PRINCIPLES

Planning principles, their role and background—ideal models in relation to the arithmetic features of the Area.

### 2. HYPOTHETICAL DEVELOPMENT MODELS

Scope and context of study—classification of development policy objectives—diagrammatic application to the Growth Area—alternative hypothetical models: monocentric; linear; polycentric—analysis matrix of models

### 3. ASSESSMENT: THE URBAN REGION

Monocentric development model—linear development model—polycentric development model—conclusion

The problem of shaping settlements does not only request sensitive intuition and imagination; it also demands careful, objective analysis. The initial "diagnosis" revealed by the Planning Implications, based on survey and analysis of existing conditions, should be first formulated. Following this, an investigation must be carried out to discover which physical development patterns should be pursued to eventually provide an appropriate form to the whole

system and its components. Therefore, the study of the possible Models which can be applied to the analyzed Area is of key importance in any planning process. This Chapter then deals with the initial phase of studies leading towards the formulation of the optimum development patterns for the whole Area and is followed in Phase Two by similar investigations for its main components: the urban structure, the road system and the recreational network.



## Research Studies: Possible Development Patterns

### 1. Model Research Process and Planning Principles

All regional development plans are a physical representation of planning principles which guide their ultimate formulation to a great extent. It was therefore considered appropriate to introduce this study as a brief review of the early stages of the planning process, attempting to clarify the inter-relationship between principles, planning policies and development plans. This should enable a more precise examination of the final Advisory Development Plan for the Grangemouth/Falkirk Growth Area by helping to assess its implications in the light of a comprehensive planning process.

The source of planning principles is manifold, but they mostly share a common concern for the identifiability of social values, translated into a series of development hypotheses which will guide development, and ultimately define the physical environment. They are based on analysis of human environmental behaviour, and usually stress different aspects of social intercourse taking place within a physical framework. They often take a diagnostic form or establish standards, and refer to aspects of an ideal environment for both the individual and the community.

Planning principles usually develop as propositions, establishing a desirable scale of urbanisation, condensing the size of settlements within the urban region; and assessing the relationship of residential to industrial and recreational areas and community facilities. Detailed consideration of environmental qualities at the scale of the residential district, the location and size of industrial sites, and the dis-

tribution of services are set within a regional framework. Other principles stress a desirable pattern of linkages, establishing priorities for certain types of mobility and accessibility for specific functions.

In the course of the history of planning, authors have often organised and represented sets of such principles, thus formulating schemes for ideal communities. Thomas Ringer<sup>11</sup> has defined these communias as a form of presenting goals regarding the environment. They deserve attention in so far as they are used to show how planning principles of general applicability are developed. They are further described as being composed of inter-related proposals giving a general view of the urban environment, and as embodying ideals with potential practical consequences encouraging programming and implementation.

Nevertheless, establishing such ideal development schemes is of limited value in the planning process. An ideal theoretical development model of a region, separated from reality, can ultimately do nothing more than exist some essential general problems. Therefore, for an operational development plan such as that being undertaken for the Grangemouth/Falkirk Growth Area, the formulation of such ideal models was based on the authentic physical features, limitations and potential for expansion of the Growth Area.

<sup>11</sup> see 'The Place of the Ideal Community in Urban Planning', by T. A. Ringer

### 2. Hypothetical Development Models

#### Scope and Context of Study

This study of development alternatives which was based on both theoretical and practical considerations had the following purposes:

To illustrate planning principles, according to which the Growth Area could develop in the light of both its particular limitations and its potential for expansion.

To strengthen a unifying development concept for the Growth Area as a whole. This should prove a realistic approach if the Area, at present under six different Local Authorities, is ultimately integrated and controlled by one Regional Authority.

To provide an adequate framework for the Consultants' final planning proposals.

The need to reconcile policies conceived within the national context (U.K., Scotland or central urban Scotland) and their potential effect on the physical extent of the Growth Area, has demanded a careful approach and sense of proportion.

The "Programme for Development and Growth for Central Scotland" (HMSO 1963) provided the necessary basic framework for defining the context of the study. Its policies define the location and requirements of the Grangemouth/Falkirk Growth Area within a wider context, and formulate the potential relationships and linkages between it and the other Growth Areas. In turn, the problem of inter-relationships between Growth Areas posed the question of mobility, and, subsequently, the degree of balance and self-containment required by each area in its proposed development.

## Classification of Development Policy Objectives

A general analysis of development policies, coupled with the selection of suitable physical planning principles, led to the formulation of certain specific potential development policy objectives which could be of importance to the development of the Growth Area. They were classified into the following five groups:

- 1 demographic and sociological factors
- 2 economic development
- 3 infrastructure
- 4 environment
- 5 programming and implementation

Each group included objectives of a varied nature, concerning both general and detailed points of policy within the fields of socio-economic and technical development and administration.

## PHYSICAL FORM CONTENT OF HYPOTHETICAL DEVELOPMENT MODELS

The selected Development Models were first analysed in terms of their physical form content. Simple geometrical and arithmetical aspects of two-dimensional forms were considered, and the analysis mainly stressed the following issues:

- 1 basic general form of development
- 2 hierarchy of the parts
- 3 differentiation of land use

Each Model was thus described in terms of its locational strategy, defining aspects of centralisation and decentralisation of development; hierarchy of centres; accessibility factors; flexibility of development; and potential for expansion. The primary distributor road system was outlined, linking the various land uses and defining the urban structure. The existing land use and some specific survey factors of the Growth Area (in particular, natural features affecting the suitability of land for development purposes) were also brought to bear on the analysis. Finally, considerations on the function of the various centres were summarily formulated. In this way, each Model stresses a specific relationship between abstract locational factors, site characteristics and ultimate planning functions. To make the comparisons as objective as possible, a similar degree of urban development for a population of some 250,000 people was envisaged for all Models.

## DIAGRAMMATIC APPLICATION TO THE GROWTH AREA

### Physical Form and Development Policy Objectives: The Matrix

The selected development policy objectives and Hypothetical Development Models are co-related in a matrix-diagram (see later "Hypothetical Development Models—Analysis Matrix"). This diagram shows which Model is the most suitable for each of the policy objectives. Most of the relationships can be directly assessed, but others have needed further consideration and analysis. The more complex problem of objectively evaluating this analysis has been attempted only in a very basic manner, and quantification has been restricted to positive statements only; therefore, the system does not pretend to show more than one way of presenting the relationship between development goals and physical structure, which is essential to all regional development plans.

## Analysis of Alternative Hypothetical Development Models for the Grangemouth/Falkirk Growth Area

These Hypothetical Development Models were analysed in the Matrix diagram and were found to be adequate to meet the specific requirements of the Grangemouth/Falkirk Growth Area, and to offer simultaneously a clear statement on the shape of potential physical development. They varied from large scale concentrated expansion defining one urban region, to decentralised development strengthening the Growth Area's existing open settlement pattern. They can be designated: Monocentric; Linear; and Polycentric.

### Monocentric Development Model

This Model (see Map No. 44, "Hypothetical Model 1—Monocentric") postulates a major economic development around Falkirk, linking it to Grangemouth, Larbert, Linlithgow, and Bonnybridge. This peripheral expansion would define one central urban region with one single town on each side (Bo'ness and Denny).

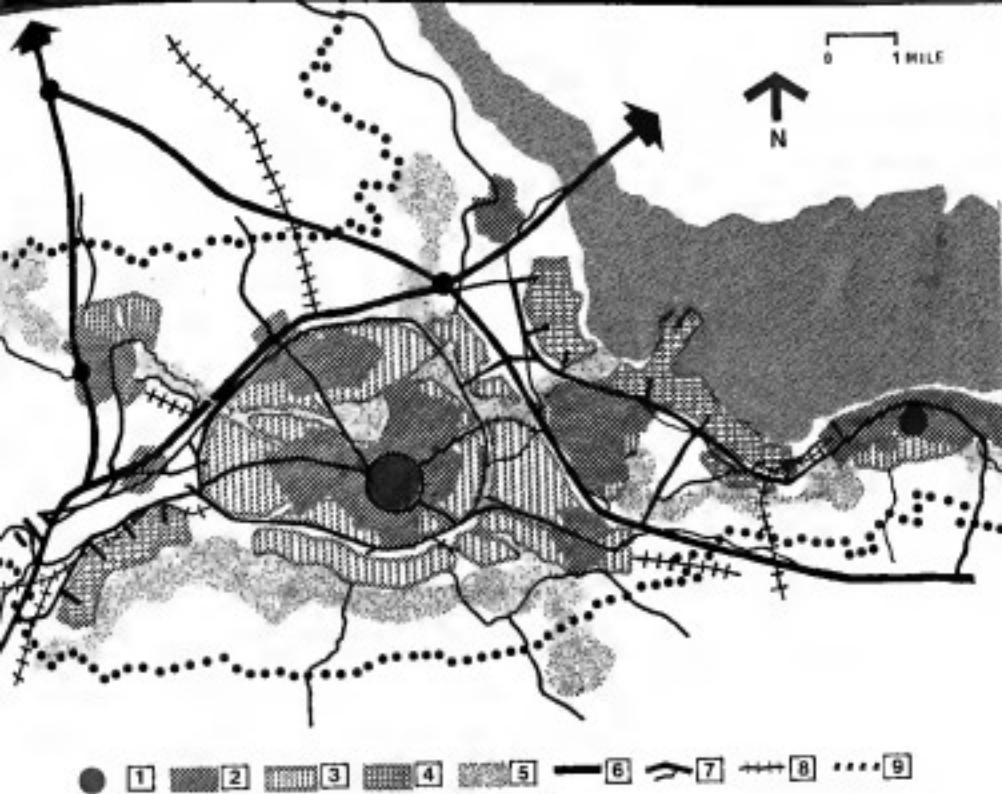
Periphery: This scale of peripheral growth round Falkirk would demand considerable reconstruction of the present settlement network. Most towns would lose their present clear geographical identity and be replaced by a continuous built-up area. Industrial development is concentrated in two large industrial estates, at the extremes of the Growth Area, and unrelated to the residential areas. A peripheral greenway system is developed on the southern limb of the built-up area. Another recreational belt makes its way along the Forth water course and through residential districts, linking with a central urban park near Falkirk Centre.

A main regional centre for the Growth Area would develop at Falkirk, based on its present town centre facilities. Due to its geographical position, Bo'ness would have its own, local centre. The primary distributor road network would develop a two ringed radial pattern, focusing on the regional centre. Various main routes would give access to the industrial zones and link the developments at Bo'ness and Denny.

Promotion: The Growth Area's urgent need for redevelopment is given main priority. Urban renewal of central urban districts and rehabilitation of scattered obsolete industrial sites should promote expansion, together with a wide policy of infilling and rounding off of residential development. Redevelopment of the central urban districts at higher densities than the existing ones, coupled with greatly improved road accessibility and the provision of an expanded centre, should allow for the redefinition of community facilities and centres of employment.

The major recreational facilities are mostly intended to the residential development, except for the large urban park which would function in collaboration with the Centre and would provide specialised entertainment for a wide catchment area. Incoming industries would be confined to two large areas of different site characteristics, which could perform complementary functions. Thus, Bonnybridge industrial area should be developed as a labour intensive zone, as opposed to the present capital intensive industry at Grangemouth.

The new Regional Centre would have a catchment population of at least a quarter of a million people more than the Growth Area's target, and would have excellent accessibility by public transport. It should be large enough to warrant shopping facilities which



Map No. 44. Hypothetical Development Model 1—Monocentric

Key: 1. Urban Centres. 2. Existing residential areas. 3. Proposed urban expansion. 4. Existing industrial areas. 5. Major green systems. 6. National road system. 7. Primary and district distributor roads. 8. Railway lines. 9. Growth Area boundaries.

provide a highly specialised range of consumer and durable goods, and a wide diversification of employment in the service sector. Labour intensive industry, particularly office employment, would be developed to counteract the present out-commuting from Falkirk.

#### *Linear Development Model*

The Model (see Map No. 45, "Hypothetical Model 2—Linear") develops two parallel east-west linear expansions of dissimilar size, with centres at Falkirk and east of Denny. An industrial-economic belt runs between them along the River Carron. Bonnytoun remains an independent settlement.

**Form:** Peripheral growth extending in a compact linear form would develop on undeveloped areas, linking most of the now isolated settlements through large scale infillings Denny-North Broomage in the north, and Bonnybridge-Falkirk-Laurieston-Palmerston in the south.

Linear industrial development would extend from both extremes of the Growth Area, incorporating existing industrial sites. The western extension would stretch from Stirlings on the waterfront to Carron and Bainsford, and would include the industrial districts of Falkirk, where some residential areas would be redeveloped for industrial purposes. The eastern industrial area would develop from Bonnybridge towards Carsearks.

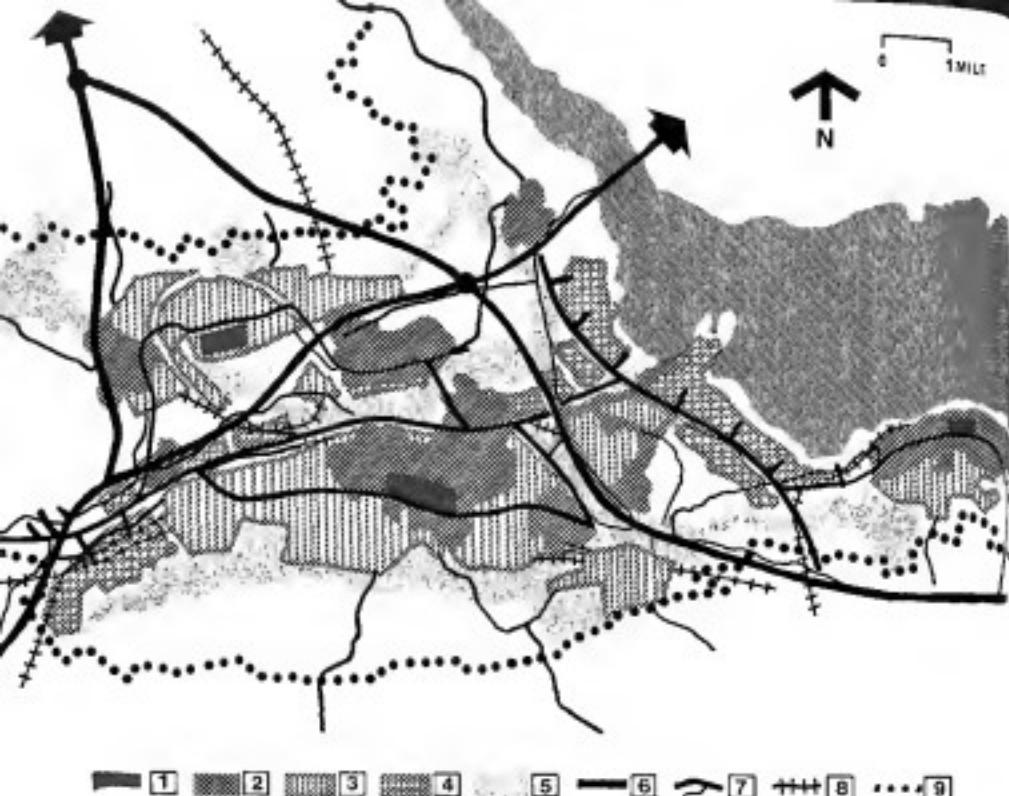
A major landscaped greenway runs along part of the industrial development, with concession recreational facilities, and serves as a green link between the two industrial areas.

A linear district centre would be centrally located within each linear expansion; a large one based on Falkirk's present Town Centre, and a smaller one, newly developed, to the east of Denny. The primary road system would consist of a main spine linking all industrial sites and recreation facilities along the valley. The main distributor loops from it would give access to both centres.

**Function:** Linear expansion along the major communication routes would have an early priority to define the major elements of the general urban structure. Residential densities would be highest near the main district distributor roads, to ensure a general good accessibility to both centres. Community facilities would follow a linear pattern of location, either in the centre or in the periphery of the linear development.

The central green belt would be strongly linked to the industrial sites and would provide amenities for the workers in manufacturing industries. Ample space and adequate landscaping would be a major attraction for incoming industries.

Direct accessibility for industrial traffic to all industrial areas would ensure the possibility of



Map No. 45: Hypothetical Development Model 2—Linear

Key: 1. Urban Centre. 2. Existing residential areas. 3. Proposed urban expansion. 4. Existing industrial areas  
 5. Major green system. 6. Network road system. 7. Primary and district distributor roads. 8. Railway lines.  
 9. Growth Area boundaries.

establishing industrial linkages, and would provide a wide choice of inter-related sites with varied characteristics, from the areas at Skinfair and Kinnel, to the higher areas round Bonnybridge. All industries would have a good supply of water and facilities for discharging of effluents.

The two distinct centres would each mainly cater for their own linear development, and would therefore differ in size and character, and be complementary in function. The major Centre at Falkirk would develop still further from its present stage, combining facilities for shopping, cultural and educational activities, and entertainment. The Centre east of Denny would be totally new, and could be located at Oakbank Wood, and have maximum accessibility from the intersection on the new A876 bypass. It would combine shopping with indoor recreational facilities. Both centres would be predominantly car-orientated with high ratios of car parking area to sales area. There would be provision for convenient and durable goods, and both daily and weekend shopping needs would be served.

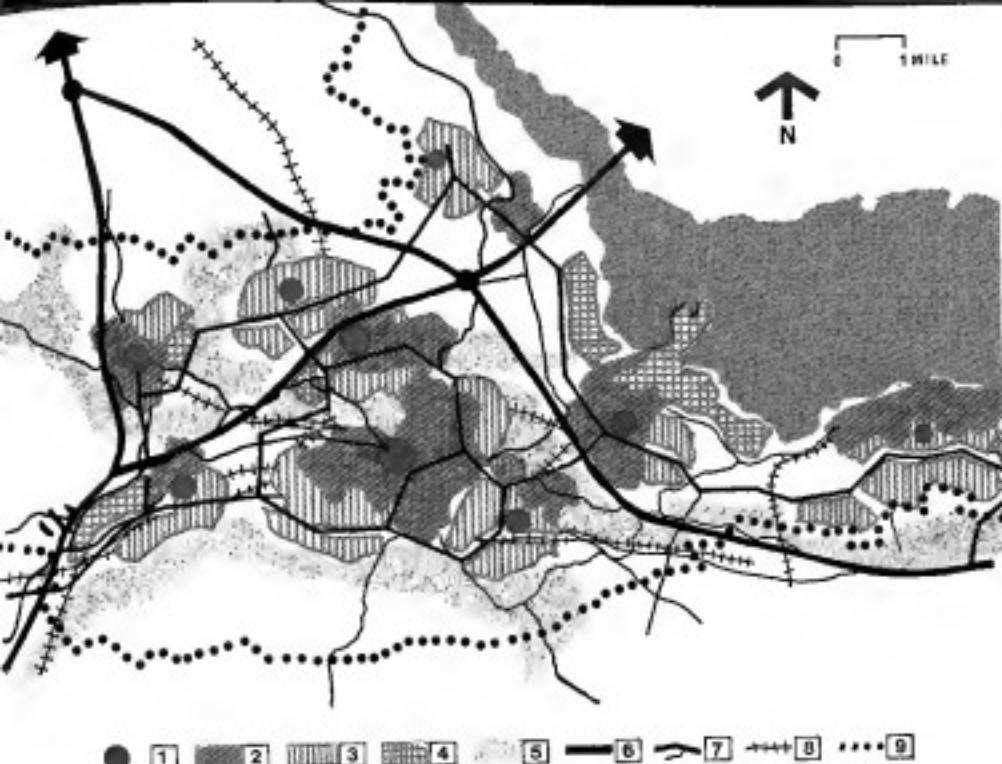
#### *Polynucleated Development Model*

The Model (see Map No. 46, "Hypothetical Model 3—Polynucleated") suggests a limited expansion for all existing settlements, simultaneously creating new areas of development. All towns are linked by a major greenway system.

*Form:* The Model stresses the Growth Areas' existing settlement structure as the basis for future development. Each separate town is expanded in various directions while new urban areas develop on unbuilt land; all settlements, existing and new, would maintain their physical identity. Most of the towns have a small industrial area closely related to their residential development, while two larger sites are located at Grangemouth and Bonnybridge.

A complete greenway system runs throughout the Area as the major component of the scheme, extending continuously from Denny to Be'twa. The network follows some dominant topographical frames, such as the hilly areas south of Falkirk and Be'twa, and east of E. Denny, and the Carron Valley. Each separate settlement has a local centre, often located in the middle of the development. Most of them would be expanded and improved versions of the existing town centre, Falkirk being the largest. The primary road system would be an irregular version of a hexagonal network, linking all centres and industrial sites.

*Function:* All settlements would undergo a process of similar balanced growth, according to their specific potential for urban expansion. The redevelopment of obsolete housing areas and centrally located derelict industrial sites should have a main priority, together with small scale settling of unbuilt pockets of land. This would take place at higher



Map No. 48: Hypothetical Development Model—Polynucleated

Key: 1. Urban Centres. 2. Existing nucleated areas. 3. Proposed urban expansion. 4. Existing industrial areas. 5. Major green spaces. 6. National road system. 7. Primary and distributor roads. 8. Railway lines. 9. Growth Area boundaries.

densities than those existing, and the community facilities would be re-located, in closer connection with the local centres. This would attract more middle-income housing, especially near Densby and Alth.

The greenway system would consist of a continuous belt of well-developed open space, providing an adequate setting for the location of main recreational and educational facilities, linked by an extensive pedestrian network. Major rehabilitation and landscaping should take place at an early priority, and the system would include archaeological remains existing in the Area, and pockets of unspoiled rural environment. Small manufacturing industries would have a good opportunity to settle in the Area, occupying a number of sites with varied characteristics, and ready to provide employment to labour intensive industries. Finsoppe, located in the periphery of built-up areas, should encourage work journeys on foot.

All towns would have a local centre with shopping and other community facilities. Each would cater primarily for the needs of the local town population, but there would probably be some overlapping of catchment areas because of the proximity of the various settlements. At Falurk, the centre would remain in its existing form, and would continue to act as a district centre.

## Hypothetical Development Models Analysis Matrix

### MODELS

- |                  |     |
|------------------|-----|
| 1. Monocentric   | (1) |
| 2. Linear        | (2) |
| 3. Polynucleated | (3) |

### POLICY OBJECTIVES

(A) DEMOGRAPHICAL/SOCIOLOGICAL FACTORS	Models which fall in this row
Rate of Growth	(2)
Overall Migration Resistance	(2)
to Change	(1)
Social Contacts	(1) (3)
Class Structure Working Popula-	
tion	(1)
Class Structure Middle Income	
Families	(3)
Provision of Specialised Com-	
munity Facilities	(1)
Shopping (Consumer Goods)	(3)
Shopping (Durable Goods)	(1)
Travel to Work (Private Car)	(2)
Travel to Work (Public Trans-	
port)	(2)
Travel to Work (Pedestrian)	(3)
Job mix category (4)	(1)

### 3. Assessment: The Urban Region

### **Monocentric Development Model**

This Development Model shows the advantages and consequences of large expansion encouraging economic growth. A city-type urban environment, such as the one proposed, would minimize the resistance to change of the overspill migrant population from Glasgow, providing greater opportunities for social contact. The attempt to provide the centre with ample provisions for service employment would address the Area's present imbalance of the employment structure, affected by the lack of labour intensive industries. This measure would be encouraged by the Government's present policy of greater control over the location of tertiary employment.

Although the scale of the redevelopment at the early stages of the programme would mean an expensive first phase, this would be somewhat offset by the central location of the redeveloped areas, benefiting from the existing public utility services network. The scheme also overcomes the Growth Area's existing fragmented administrative boundaries, and leads naturally towards establishing one regional authority to control all development.

Drawbacks to the scheme are probably a limited choice of sites for manufacturing industry, which would restrict the possibilities for establishing convenient industrial linkages. Accessibility to the industrial areas is also limited, in particular for railway freight transport. The development of the northern areas, especially to the east of Larbert, would involve negotiation with the N.C.B. It could also be noted that the Model pays little attention to the rural environment and its possible integration with the urban dimension.

The Model envisages the expanded Growth Area as the third largest new agglomeration in central urban Scotland, located between Glasgow and Edinburgh. It could thus also attract a future overspill population from Edinburgh, which is certain to develop during the next decade.

An urban region with three main cities could be functioning by the 1980's, similar to the West Netherlands, where Amsterdam, Rotterdam and The Hague perform complementary functions within one comprehensive regional context. This would be beneficial to the hierarchy of the present settlement structure of urban Scotland, and would avoid unnecessary conflicts between the Growth Area and a number of existing and new middle-sized towns of similar status now developing in Central Scotland.

### **Linear Development Model**

The Model stresses the benefits for industrial development to be derived from the linear form.

The main road network provides optimum accessibility to the industrial areas and district centres, and allows for a certain flexibility in the choice of routes. The alignment of the central spine road would take place along the Ruth-Clyde Canal and from it various distributor loops would provide good servicing of industrial areas. The extensive development of industry around Bonnybridge would help to avoid traffic congestion and balance the flow which at present concentrates too heavily in Grangemouth. The Model would allow for the economic development of rapid public transport along roads linking the industrial sectors to the residential areas and to the two centres. It would also facilitate the reduction of motor vehicle numbers.

Shortcomings would be due to the Growth Area being divided into two parts, and to its east-west linear development being hampered by topographical features (steep slopes near Denby and Bonnybridge) and by 400 kV. electricity cables. The implementation of the central industrial belt would entail the demolition of housing areas at Blainsford, and the main spine road would have to negotiate the north-south railway. These costly operations should have early priority to facilitate industrial development in the early stages of the Plan. Such a scheme for

Growth Area would further stress its present industrial function, by encouraging the development of more capital intensive manufacturing employment.

As an urban sub-region, lower Grangemouth/Falkirk would have a status similar to that of other major settlements in urban Scotland, with the following main functions:

Grangemouth/Falkirk:	Secondary industry
Cumbernauld:	Complementary shopping centre
Sterling:	Higher education
Ludithgaw:	Middle-income housing
Lothians Region:	Tertiary employment
This would ensure a comprehensive and balanced functional development of the urban region of Central Scotland.	

### Polynucleated Development Model

This Model stresses the advantages to be derived from the moderate expansion of middle-size settlements and the conservation of the rural environment. All urban growth would be strictly controlled and emphasis laid on early rehabilitation of the existing industrial dereliction and the comprehensive development of the greenway system. Preserving the existing settlement structure would also ensure a first phase economic development, maximising the use of existing utility services networks and road systems. Further positive implications from this policy of deconcentration for both residential and industrial areas would be the avoidance of traffic congestion, and the facilitating of design of environmental areas with convenient traffic segregation. Localised urbanisation would also encourage the preservation of existing agricultural land, archaeological remains, and, in general, the rural society; this, in turn, would attract more middle-income housing, which would give the Area additional possibilities for economic growth.

The scheme's main shortcoming would be on the expansion of the Growth Area's industrial development, which is its present major function. Very indirect accessibility, in particular between centres of employment, would hinder industrial linkage. Small town centres would offer little opportunity

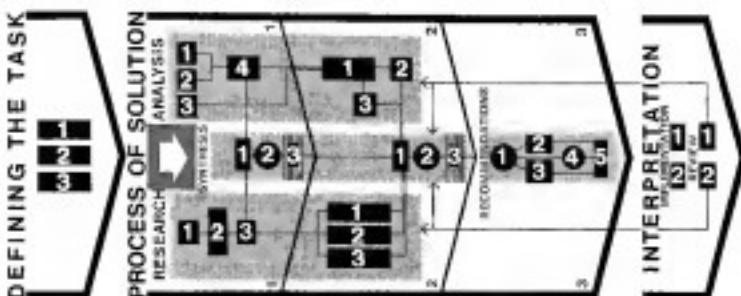
for alternative tertiary employment, and the migrant population from Glasgow might feel strongly the change in scale and character of the urban environment. Decentralisation might also discourage the idea of amalgamating administrative boundaries under one planning authority.

The Model implies a departure from the Growth Area's present main industrial policy within the context of Central Scotland. By possibly limiting industrial expansion, and stressing the development of the rural environment, it would attract more middle-income housing, and possibly encourage the location of some major recreational or educational facilities with a wide regional catchment. Nevertheless, because of the scale of its present industrial development, the Area would still provide an important centre for secondary employment. This splitting of functions would weaken its power of attraction on a regional basis, but would encourage its balanced internal development. In the hierarchy of settlements within Central Scotland, the Grangemouth/Falkirk sub-region would be comparable to Cumbernauld in attracting industrial development, and to Ludithgaw for middle-income housing. This sense of competitiveness between Growth Areas could promote further economic growth within the urban region of Central Scotland.

### Conclusion

The analysis and assessment of the alternative Hypothetical Development Models have broadly attempted to outline three potential policy frameworks along which the urban sub-region could develop. All Models correspond to general sets of specific policy objectives and have been found to have both advantages and shortcomings. All have shown a potential contribution towards an optimum development policy and plan for the Area. Most of the policy issues analysed will have to be reconsidered and the final policy to be adopted will have to attend to the particular factors emerging from a deeper study of the Growth Area. This will involve necessary adjustments of the proposals outlined to enable the adequate formulation of an operational development policy and plan for the Growth Area.





## First Synthesis

### 1. BACKGROUND TO PHYSICAL DEVELOPMENT

**DEMOGRAPHIC BASIS:** The target population for 1986—natural increase—immigrant population

**ESTIMATION OF LAND NEEDS:** The present land use distribution—adapted land use standards for (a) industry and (b) other uses, and additional land-use requirements

**ADOPTED DEVELOPMENT OBJECTIVES:** Regional character of the settlements—residential areas—community facilities—industry—recreation and open space

### 2. PHYSICAL STRUCTURE: MODEL 7

**LAND USE:** Residential and ancillary uses—industry—retirement open space—agriculture and forestry

**POPULATION DISTRIBUTION:** Directions of urban growth—population distribution

**TRANSPORTATION:** The national traffic routes—public transport

### 3. TESTING MODEL 7

**SERVICES:** Drainage—water supply—sewer disposal—other services

**TRANSPORTATION:** Roads—sites

**THE DEVELOPMENT PATTERN:** The green belt—former mining areas—industry—housing—recreation

These three sections present the first synthesis of the background data and analysis which supports the preliminary proposals for the new structure. They demonstrate the reasons for the choice of development model, its requirements in terms of space for different activities, and the overall development objectives. Regional Model 7 is de-

scribed in terms of the distribution of the population and the main urban functions. The model is tested and observations of officials and specialists concerned with the provision of services and transportation networks and the implementation of the regional development structure are considered.



## First synthesis

### 1. Background to Physical Development

A first synthesis of all the information previously analysed can now be seen in the development model structure, chosen as most clearly defining the aims for the Growth Area within the context of Central Scotland. These aims are:

- to promote the development of the urban region into a physical structure consistent with the "Growth Area" concept
- to unify the development structure into one identifiable whole, i.e. either under one authority or as a distinctive sub-regional unit
- to create a proper balance of functions within the physical structure, i.e. a considerable degree of self-containment
- to provide the most satisfactory environment for meeting specific urban goals

It is also possible to incorporate certain of the advantages of the two Models which were rejected.

Although the Linear Model offered a specialised function of industrial concentration with the intent to achieve a well-defined and economic structure, other urban functions were unbalanced in scope and physically hampered or restricted development. The Growth Area was also effectively bisected to no advantage.

The Polycentric Model utilized the present structure and range of urban facilities, and lessened congestion by decentralisation, but full potential for industrial growth could not be realised. This fragmentation of effort would also result in restricted community facilities and induce accessibility, and would not encourage unification of administrative or physical structures.

The Metacentric Development Model which was chosen will encourage economic growth through concentration and unified expansion, thereby making the Growth Area the third largest centre in Central Scotland. It will support an adequate balance of functions, providing that the limited choice of industrial sites can be made attractive to industrialists, and acceptable commercialisation are established. It will allow the most comprehensive possibilities of building up a satisfactory urban environment, thereby also making good any deficiencies in the existing urban situation.

The detailed requirements of this Model are now investigated for application at a more local level.

#### DEMOGRAPHIC BASIS

The White Paper on Central Scotland which formed part of the brief for the Glasgow/Falkirk Growth Area Plan proposed an increase in population of 200,000 in the Area after twenty years.

It was estimated that by natural increase the existing population of the Area (approximately 124,000) could be increased to around 145,000 by 1986.

From their initial studies, the Department of Socialized Economic Research in Glasgow University suggested that an influx of 30,000 immigrants spread over twenty years, with their natural increases, might bring the total population to around 251,000 by 1986, and 289,000 by 2001. This figure would be sufficient to ensure increased opportunities in employment, and a labour pool adequate to induce new industries to the Area, while increasing the range of educational and social facilities. This is on the understanding that there is enough "buildable" land for the satisfactory accommodation of such numbers.

This tentative estimate of future population was kept in mind during the studies of land availability and alternative Development Models, and now forms the basis for estimations of land needs and the chosen regional structure.

#### ESTIMATION OF LAND NEEDS

Allocation of land for each function will only be made within areas already defined as having growth potential for that particular function. Allocation will also be governed by certain standards, adopted either because of their suitability for the particular situation (judged against the present standards, or because these standards are recognised as satisfactory in similar circumstances).

Calculations for land-use requirements will be made on a broad basis to allow flexibility of interpretation at this stage, and for that reason are apportioned into future requirements for (a) industry and (b) other uses. This does not necessarily mean acceptance of existing conditions, but defines in the present land-use structure can mostly be taken up in better utilisation of present uses. The standards adopted here will be refined later to produce ultimate land-use totals, after more detailed studies into each function.

#### Present Land-Use Distribution

The Survey Area covers approximately eighty two square miles (22,875 acres), the actual urbanised area being approximately 8,200 acres. Adjusted figures from the 1961 Census give a 1965 population of approximately 130,000. Some nineteen hundred acres are used for industrial purposes (excluding docks), and the overall gross urban density is approximately sixteen p.p.a.

Land allocated for future industry will include not only manufacturing, but also service industries most suited for industrial estates, and an adjustment

to the land-use standards can make allowance for this. It can be assumed that approximately one-third of service employment would be of this type. Allocation for all other uses will cover residential and associated functions such as commerce, public and community buildings or institutions, as well as public and private open space where used for recreational purposes.

### Adopted Land-Use Standards

#### (a) Industry

The industrial survey showed that the lowest employment densities were in Grangemouth where the average density is five w.p.a., due to the extensive area used by the oil refinery, which has a density of 0.67 w.p.a. Many new industries attracted to that area might also be expected to be "capital intensive". However, since further diversification of industries should be encouraged (see Chapter 4, Volume One), higher employment densities should be anticipated. It is necessary therefore to allow for flexibility in allocation, especially since many service industries also have lower employment densities. An overall density of twenty w.p.a. had been adopted in the Lothians Regional Survey and Plan as being satisfactory for Scottish conditions generally. In this particular situation, however, an overall density of fifteen w.p.a. will be adopted to accommodate some service industries and extensions of the petro-chemical concern. It can be assumed that forty per cent of the population will be employed. Of this total, sixty per cent of employed persons would work within industrial estates, forty two per cent of the total employed being engaged in manufacturing industries.

#### (b) Other Uses

The present gross density for all uses other than industry in the Growth Area is approximately twenty-two p.p.a. Land allocated for these functions in the London New Towns gives a density of 19.6 p.p.a., and in the Scottish New Towns 27.5 p.p.a. (excluding golf courses).<sup>[1]</sup> The difference is due to the much higher residential densities achieved in Scotland. Since it is proposed to intensify the urban structure further in the Area (ref. Adopted Development Objectives), then a density nearer the latter should be aimed at. A gross density of twenty-five p.p.a. will therefore be adopted.

Additional land-use requirements are:

Proposed increase in population over 1965 figures	151,000
Additional industrial land required (at fifteen w.p.a.)	1,620 acres
Additional land required for other uses (at twenty-five p.p.a.)	4,940 acres
Total additional land required	5,660 acres

Because proposed industrial densities are low and proposed residential densities higher than that existing, the overall gross urban density will only be slightly higher than at present.

## ADOPTED DEVELOPMENT OBJECTIVES

General development objectives have been adopted to guide the preliminary development proposals, the overall structure of which is derived from the Development Model chosen. They are described within the main functions of the structure and will later become the basis for more detailed studies into functional and environmental standards.

### Regional Character

The Growth Area should be planned to accommodate 251,000 population by 1986, by creating a large urban complex stretching from Denny through Larbert, Stenhousemuir, Falkirk and Grangemouth. Bo'ness will remain a separate urban unit focused on Falkirk, which will continue to be the Regional Centre. This community will be made more cohesive in its urban character than at present by redevelopment and infilling, and by new development. New development will be located to strengthen links between Denny and the rest of the Growth Area, but the Larbert-Brighton area will continue as a more rural scattered development, and will be expanded very little. The total population will be grouped together finally into settlement units, each with a population of from 20,000 to 50,000, and each with a district centre, but related to the Regional Centre.

It is hoped that a satisfactory environment at regional and local levels will be achieved through a high quality of design and adherence to the Development Objectives adopted. Present areas of unsatisfactory environment will be upgraded where necessary. The density and concentration of development will increase towards the central areas of settlements and towards the Regional Centre.

Traffic will be canalised on to an hierarchical network resituating flows and type of vehicles according to the function of the area.

### Residential Areas

Only areas where a satisfactory environment can be achieved will be considered for development.

Residential development will be within Environmental Areas at sub-divisions of the settlements. A variety of local environment will be possible by ensuring a range of development types including both Local Authority and private development. A proportion of residential development will be located in central areas.

Densities will have local variations, but the average regional figure will comply with MODUS recommendations<sup>[2]</sup> for new development. Redevelopment of central residential areas will be at higher densities than the regional average.

Integration of old and new communities will be encouraged by design of layouts and location and distribution of social services, recreational and shopping facilities.

Residential areas will be served by an hierarchical road network but environment will take first priority. Radburn principles will predominate, and increasing car ownership levels will be expected. A separate system of pedestrian circulation, based on debit lines, will penetrate the Environmental Areas, and will link the better areas with local community and recreational facilities, and with district centres and district parks.

### Community Facilities

Little competition is expected from Cumbernauld's centre, although population on the south-western fringe of the Area may be attracted by later phases of its development. A balancing proportion may be attracted to Falkirk from Cumbernauld. Little or no loss of shoppers to Brightons or Livingston is expected, because only limited facilities will be available for some time yet, and because the route is indirect. The location of facilities in the Area will be closely related to the distribution of population catchments.

[1] see "Land for New Towns" by R. H. Best

[2] Planning Bulletin No. 3 (1968)

The range of provision and facilities in all areas will be based on higher affluence and site ownership levels (see Chapter 5, Volume One). Falkirk will be the main focus of the Area and will provide a comprehensive range of facilities as Regional Centre; it will provide areas of concentrated uses, such as entertainment, so that it will be attractive after shopping hours.

An hierarchical system of shopping and local community facilities will be distributed throughout the Area, and settlements will have distinct centres which offer a limited range of facilities, and thus maximise the attraction of the Regional Centre. Local shops and local community services will be dispersed throughout the Environmental Areas for convenient use.

The Regional Centre will contain pedestrian-only areas and car parking adjacent, and access points to the public transportation systems. Due to the contours of the land, circulation may be achieved both on several levels.

It will be possible to reach all district and local community facilities by pedestrian only routes. District centres will provide parking facilities, as well as having good access by public transport from the residential areas. Many social and community facilities, i.e. secondary schools and Roman Catholic schools, health clinics and libraries, will require to be served by bus routes.

### Industry

The following principles will apply to all three main groups: extractive, manufacturing and service industries. There will be sufficient jobs for the total population, assuming a balancing proportion of incoming and outgoing flows. Only reasonably level sites will be considered for development.

Main industrial concentrations will be located in relation to centres of population in order to distribute heavy traffic generation and journey-to-work flows. New industry will be concentrated into

two substantial estates, of possible linking with present sites, to construct present, harmonised dispersal, and lesser effects on residential areas.

Where the location is otherwise suitable, sites needing rehabilitation will be developed in association with extractive industries and refuse disposal schemes. A suitable site will be kept in reserve for a possible major head works; and sites will be looked for in the west of the Area to provide possible locations for expansion of Cumbernauld's industrial needs. Only very light or service industries will be situated within or close to residential areas.

Maximum accessibility will be ensured between industrial estates, and with the port, national roads and railways. Commercial traffic will be carried for by special access roads in industrial areas. Journeys to work will be by the most direct route.

### Recreation and Open Space

Any area adjacent to the main urban complex which is under-utilised, unsuitable for building, and has attractive natural features, will be an obvious choice for recreational use.

The coastline will be utilized wherever possible. Large areas of water (i.e. the Firth and the rivers) will be exploited. The canal system will be incorporated into the recreational network for fishing and canoeing, to prevent it becoming a liability and possible danger. The attraction of the countryside is accepted, and access will be considered, especially to woodlands and areas of outstanding natural features. Where ground is at present under-utilised, it may be improved for multi-use by such methods as afforestation, and special provision for recreation may be made. Historic sites (including Roman fort sites and the Antonine Wall) should be further exploited by ensuring access from the regional greenway network.

There will be a regional and intra-regional network of pedestrian routes (greenways) taking advantage of existing linear elements, and linking the urban areas with the countryside.

## 2. Physical Structure: Model 7

At the first meeting of the Technical Committee on 7 September, 1985, the Regional Consultants presented their preliminary proposals in the shape of "Regional Model 7" (see Map No. 40 "Model 7") which gave the new physical structure of the Grangemouth/Falkirk Growth Area, formulated within the economic studies of the Glasgow team.

Growth Potential Studies had already indicated undeveloped land which is suitable for the main urban functions. Within these possibilities, the studies of theoretical physical models for the Growth Area were explored and tested, and the Monocentric Model was selected as the optimum regional structure. The first acceptable synthesis of all these factors was therefore Model 7 which showed physical structure proposals covering land-use, population distribution and transportation, as follows:

The proposed regional structure fulfils the general planning principles to create a large urban complex focused on Falkirk which will continue as the Regional Centre. Bishnu remains a separate unit, although also focused on the Centre. Large development in the Denny area now strengthens its position in relation to the other urban areas. A central regional park is proposed on land unsuitable for urban development located adjacent to the River Carron. It is enclosed on most sides by urban areas and will incorporate an existing golf course. Existing

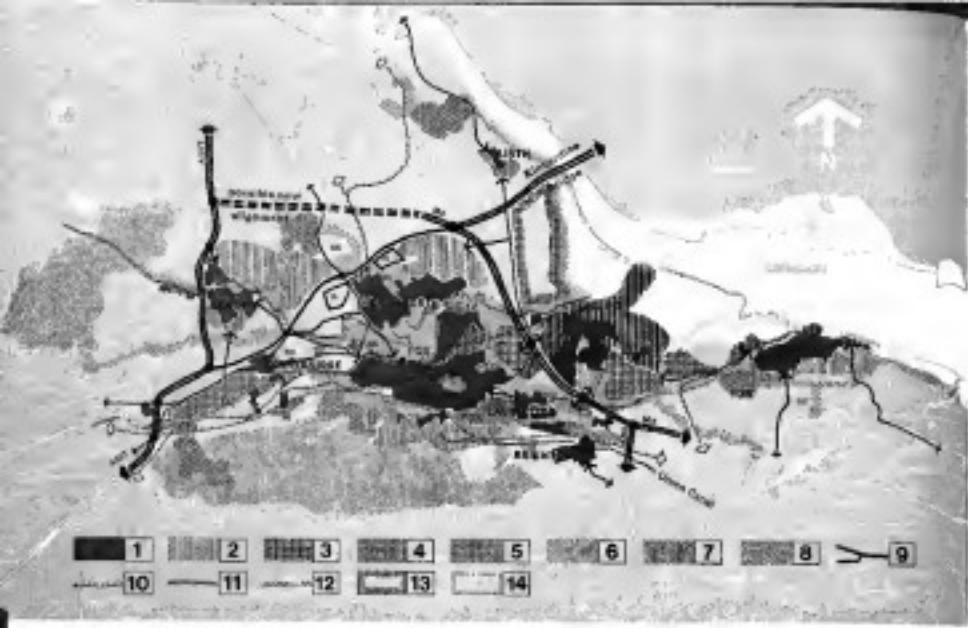
industrial land is expanded and alternative sites are proposed to split journey-to-work flows. Where possible, present scattered industries will be rationalised by selected phasing out and integration of sites. A large area of flat land with reasonable accessibility will also be held in reserve for a large-scale industry, likely to be situated by the port facilities.

### LAND USES

#### Residential and Ancillary Uses

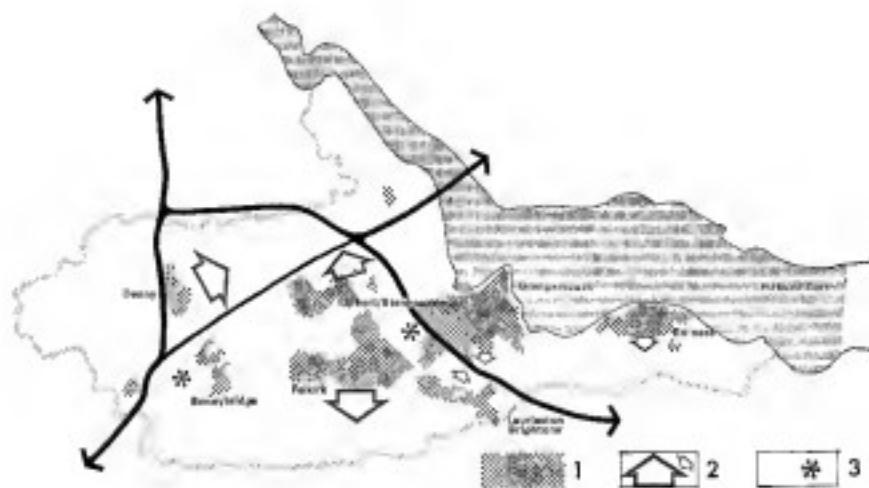
Past mining activities affect many parts of the Growth Area but in general development is possible over many of these areas. Residential development is proposed mainly for areas north and east of Denny (where a proportion of high quality housing is recommended), south of Falkirk, south of Bonnyton, and east of Strathaven. Falkirk will continue as a major residential unit. These areas are both physically suitable for development and attractive. Small areas of infilling and expansion are proposed in the Linlithgow-Polmont area, which retains its more "rural" character. Grangemouth can only accommodate limited growth through inheritance of suitable land.

Shopping facilities will concentrate on Falkirk as the commercial centre, which should provide a wide



Map No. 47: Model 7

Key: 1. Existing Residential Development. 2. Proposed Residential Development. 3. Existing Industry. 4. Possible Industrial Sites. 5. Regional Shopping Centre. 6. Riverine System. 7. Wetlands. 8. Improvement Areas for agriculture, forestry and recreation. 9. Major roads. 10. Rivers and Creeks. 11. Anterior Wind. 12. Land to be held in reserve for major new industry. 13. Area of possible land reclamation



Map No. 48: Directions of Growth—Model 7

Key: 1. Existing urban areas. 2. Directions of population growth. 3. Main industrial/concentrations

range of durable goods, and the High Street will be freed of traffic. Smaller district centres will serve the outlying urban concentrations, and will support a wide range of convenience goods, and some of the larger-scale community facilities.

The urban areas will be divided into Environmental Areas, safeguarded from the harmful influences of traffic. Residential areas will be served by groups of local shops and other small community facilities, all within a short walking distance.

### Industry

Two main areas are envisaged on a regional scale: one at Bonnybridge (providing alternative sites for Cumbernauld), and one focused on Grangemouth where industrial growth is already well established. The latter area is particularly suitable physically, since it is located between Falkirk and Grangemouth and adjoining existing industrial sites. Since there are definite advantages to be gained from further linkage of urban areas, the Green Belt at this point is seen as no obstacle.

Other smaller sites are proposed at Bo'ness, to ensure rehabilitation of derelict areas, and at Denny and Lochend, Falkirk, to ensure some local employment opportunities.

Design of new industrial estates and selected phasing will attempt to lessen all forms of environmental nuisance. A large area at Skinfoots is proposed as a reserve site for a large-scale industry, although there are rehabilitation and bearing capacity problems. This area would have good access both to the port and to the national road network.

### Recreation and Open Space

A greenway network throughout the Growth Area is envisaged, linking and penetrating all the urban areas and focused on the central regional park and other recreational areas. Main directions of movement are along the River Carron, the Antonine Wall, and the Canals. Access to the foreshore will be important north of Grangemouth, and east of Bo'ness. Links to wider areas of open space (i.e. the Shannen Plateau and the Kithly Hills) are also made. Ancient monuments and areas of historic interest (i.e. Kinnell House and Braugh Castle) will be safeguarded. An industrial museum is proposed adjacent to Carron Dock.

### Agriculture and Forestry

The area with greatest potential for improvement lies south of Falkirk at the edge of the Shannen Plateau. In effect it will be completely redesigned by extensive drainage and afforestation schemes for multi-purpose use, i.e. recreation, agriculture, and forestry. In the Denny/Kithly Hills, agreements for public access to the large areas of high moorland will be negotiated for recreational use on an "area-wide" scale.

### POPULATION DISTRIBUTION

The new distribution has been shown according to the census districts of counties, but for clarity the figures are related to the names of the present identifiable settlements. Map No. 48—"Directions of growth Model T"—also shows the directions of growth proposed.

TABLE 1

*Population Distribution: Model T*

Area	1961 Population	1980 Population	Proposed Increase
Falkirk	35,044 (burgh) plus 143	65,000	28,213
Grangemouth	18,857 (burgh) plus 1,234	36,000	9,913
Denny	3,763 (burgh) plus 1,068	40,000	31,172
Larbert/Sunninghame (plus Arth and Duncarron)	18,877 (burgh) plus 1,726	40,000	19,123 2,274
Bo'ness	13,257 (burgh) plus 990	24,000	9,743
Bonnybridge	15,963	18,000	1,037
Levenmouth, etc.	12,691	30,000	7,300
Total	124,167	251,000	106,833

### TRANSPORTATION

This has been considered on a co-ordinated basis and studies of the Grangemouth/Falkirk Area provide part of the groundwork for a future North Valley Transportation Study. More refined studies will be needed on the roads network within an hierarchical system, to take into account points to residential areas as indicated. However, national routes are shown since they provide the major framework.

The northern section of the M9 is proposed as a new alignment further south (along the Survey Area border) to give more direct access to Kincardine Bridge from Stirling, Glasgow and Cumbernauld, and to prevent through traffic using the new A876 which bypasses the Growth Area. The latter could then be used mainly for journeys within the Area, providing a link between the two main industrial locations.

It is proposed to make maximum use of the railway network, especially for journeys to work, and stations at Larbert and Falkirk would be popular for serving the expected rise in commuter traffic to Edinburgh and Glasgow.

No problems are anticipated in expansion of the bus services as required to serve all residential areas and the District and Regional Centres.

### CONCLUSIONS

This new regional structure should provide ideal conditions for economic expansion. The Growth Area will be able to attract new industries by creating conditions which management and workers alike find attractive; a well-organised transportation network for the efficient movement of goods and workers; sites which allow maximum utilisation; and industrial estates which provide decent surroundings and comprehensive facilities for staff welfare. Likewise, the new housing areas will provide environmental conditions which will attract the initial population to these jobs; a full and varied community life; safe and pleasant surroundings in which to bring up children; shopping areas where pedestrians have priority over the motor vehicle; and a townscape which is visually stimulating.

### 3. Testing Model 7

Regional Model 7 was first presented to the Technical Committee comprising representatives from all the local authority departments and areas after it was discussed in detail by the various Working Parties on services and roads, Specialist Consultants, and by the local planning officers and Government representatives. Advice and comments were requested not only on technical matters but also on general development proposals contained in the Development Model. These proposals were generally well received and views were expressed mainly on points of detail such as exact location of development and road alignments. There was however a minority opinion that the Green Belt should still be preserved between Falkirk and Grangemouth.

The main views on each aspect of the Model were as follows:

#### Services

##### Drainage

All development shown could be served by the present drainage facilities combined with committed extensions of wastewater plants and networks, though there might be gravitational problems for a very small area S.E. of Denny. Local Authorities would find it convenient to adopt joint foul drainage schemes in some cases. Separate foul and surface water drainage systems would need to be adopted as a matter of policy in all future schemes.

##### Water Supply

Sufficient supplies of potable water were available or could be made available through committed schemes. However it was desirable that regulation of supplies should be administered by only one authority instead of two. It was possible that additional water for industrial purposes could be taken from the canal system.

##### Refuse Disposal

Because of the problem of refuse disposal for the increased population it was proposed to set up a sub-committee to consider the co-ordination of waste disposal with the rehabilitation of derelict areas. It would therefore be advantageous to set up a regional pulverisation plant in a central location possibly near the sewage treatment plant in Falkirk. The reclamation of part of the Firth foreshore might also be investigated as the economics and suitability of locating an air strip adjacent to Grangemouth, and increasing agricultural land.

##### Other Services (Gas, Electricity and Telephones)

It was not anticipated that there would be any problems in meeting demand for these services. The co-operation of all bodies would be needed to ensure the most satisfactory route for 400 kV overhead electricity lines which might be developmental to housing areas near Denny.

#### Transportation

##### Roads

Concern was expressed at the need to commence detailed traffic studies before the initiation of a

comprehensive Forth Basin and Greater Edinburgh Transportation Study. The extended line of the M9 west of Leithen Moss was found disagreeable and the original line preferred northwards. The importance of a link between the M9 near Grangemouth and the Livingston area was stressed. It was also desirable that direct access between Grangemouth industrial area and the M8 should be possible at Lethalbin and therefore the location of access points serving Linlithgow and Bo'ness might be modified, to take advantage of this interchange. A relief road to the south of Falkirk centre would be useful to serve East-West traffic flows. A major link would be needed between the South West of the Area and Glasgow via Kilsyth. In order to undertake detailed traffic studies leading to a recommended road network a proposal was made to set up a sub-committee to act as a Transportation Advisory Group (T.A.G.).

##### Rail

The rail network should be utilised and services improved wherever possible.

#### The Regional Development Pattern

##### The Green Belt

Concern was felt at the infringement of the Green Belt between Falkirk and Grangemouth in a number of places for both industry and housing, particularly since it had been successfully defended for a number of years and that undeveloped land at Cammerton might have been developed instead.

##### Future Mining Areas

Development of areas subject to coal mining rights, such as at Skelmorlie (for industry) and north Larbert (housing), might necessitate compensation agreements with the National Coal Board.

##### Industry

Geological investigation of the coalfield had revealed areas liable to subsidence and other areas necessitating piled foundations for industrial development.

##### Housing

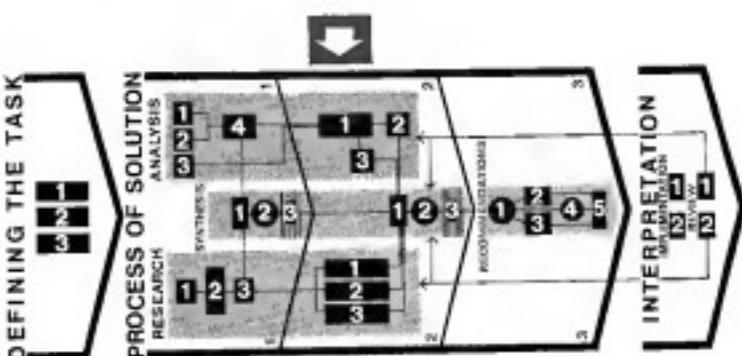
Certain areas such as Glenwood which had been suggested as attractive for middle-income housing would detract from the sonic value of the area. The proposed expansion of Alloa would be difficult to undertake in view of the considerable mine workings adjacent and because of drainage problems.

##### Recreation

It was hoped that the canal system could be more fully integrated into the regional recreational network and sites suggested to prevent their further decay.

Where the Consultants found these comments to be justified or to improve upon their proposal, they were incorporated or used as a basis for improved of the development pattern.

## Process of Solution—Phase Two



### Data and Analytical Studies: Physical Characteristics

#### 1. URBAN GROWTH POTENTIAL

**Introduction**—Threshold Theory, its origin and aims—method of analysis—stages of analysis—examination of town development possibilities—results obtained: assured finances, public utility networks, existing urban structure—definition of threshold lines as limitations to urban expansion—calculation of Growth Potential; population, industrial land.

The ultimate aim of Growth Potential Studies is to determine the possibilities of further urban development and to calculate the number of new inhabitants which could be accommodated in the Growth Area. The method adopted for achieving this was based on the Threshold Theory, which

provides a rational approach and enables the results to be presented in a quantitative form.

**Note:** For more detailed information on this subject please refer to paper by J. Kondiswki/J. Hughes, T.P.I. Journal, February 1957.

#### 2. THRESHOLD COST ASSESSMENT

**Definition of Threshold Cost**—three aims of economic assessment—application of the method, basic assumptions and analysis of three groups of threshold costs: adaption of land, acquisition of land, construction of public utility networks—conclusions: results of analysis as basis for choice and programming—implications from the Matrix of total Threshold Costs.

The Threshold Cost Assessment is an analysis of variable groups of costs for the location of new inhabitants. The main value of these costs is that by them it has been possible to define the economically

sound sequence of development of all settlements within the Growth Area. Thus, in the course of this analysis, a logical basis was obtained for both choice and programming.

### 3. INTENSITY OF URBAN DEVELOPMENT

Introduction—factors influencing intensity. Intensity of residential development—possible ranges for housing densities—adopted average density—Influences to lower or higher average density—conclusions—areas suitable for higher and lower densities. Intensity of industrial development—possible ranges in density of workers per acre—adopted average density—Influences to lower or higher average density—conclusions—areas suitable for higher or lower densities.

This study explores the possible ranges in intensity of development for both residential and industrial uses to ensure an economic and environmentally satisfactory explanation of sites. It concludes with the definition of areas suitable for variations in density higher or lower within the adopted average densities for the Growth Area.

## Data and Analytical Studies: Physical Characteristics

### 1. Urban Growth Potential

#### PRINCIPLES OF THRESHOLD ANALYSIS

##### *Threshold Theory*

To determine objectively the Growth Area's development potential a new analytical theory has been adopted which defines "thresholds" for urban growth. According to the "Threshold Theory" (formulated by B. Mahns in 1962) expanding towns are faced with limitations of a physical, technological and structural nature. Overcoming these limitations results in disproportionately higher per capita costs for each successive town expansion scheme. The analysis of these limitations makes it possible to locate "threshold lines", which define areas suitable for successive development of a particular town on a more rational and sound basis. Efficiency indices for all towns within a given region can be calculated and compared to guide development programmes and to assist the decision-making process involving major capital investments.

##### *Aims*

Threshold Analysis, the second part of the comprehensive studies leading to the basic definition of the overall growth potential in the Area, is mainly used in connection with residential functions and, to a lesser extent, with industry. Based on information supplied by Technical Committees and specialists in various fields and an direct survey by the Regional Coordinators, it attempted to define objectively those areas suitable for town expansion and to calculate the overall growth potential for the Area (by using average urban density standards). This was to prepare the basis for:

- the definition of long-range directions of growth;
- the optimum distribution of the elements of the development programme;
- the appropriate allocation of the theoretical pattern arrived at by the Research Studies;
- the calculation of the Growth Potential;
- the economic assessment from the Threshold Costs indices.

The main results achieved by the application of Threshold Analysis were the definition of areas suitable for urban expansion over the whole Growth Area and of the basis for determining the sequence of their development. This greatly helped in formulating the policy for the final urban concept.

##### *Applied Method*

As a first step towards defining threshold lines

for the Growth Area the following "Partial Analyses" were undertaken to reveal:

1. suitability of land for urban development from the natural features standpoint;
2. possibilities of extending the public utility networks and roads;
3. possibilities of changing the existing urban structure.

In the simplified graphic method used a further breakdown of each of these three groups was made, into the following categories:

- a. land unsuitable for urban development, i.e., areas for which preparation for new networks, etc., would be disproportionately costly;
- b. land meeting requirements before becoming suitable for urban development, i.e., requiring additional capital expenditure to open up given areas for urban development;
- c. land immediately suitable for urban development, i.e., areas where the cost of location of new inhabitants is relatively normal.

This breakdown also helps to formulate the results quantitatively. The cost indices can then be deducted and the amount required to open up land for urban development can be assessed.

The results were produced in the form of separate overlays for each group. The detailed content of this analysis is shown on each specific sheet presented.

The integration of results from all these "Partial Analyses" enabled the production of a workable synthesis and the definition of successive threshold lines for any town in the Area. Thus, various Threshold Areas were obtained and the urban growth potential could be calculated by using density standards.

### RESULTS OF PARTIAL ANALYSES

#### Natural Features

Natural Features were analysed in the first stage of the Growth Potential Studies as a part of "negative" and "modifiable" limitations, together with other factors affecting the suitability of undeveloped land for the main functions involved (see: Growth Potential—First Step, Residential).

Following the Threshold Analysis technique, the evaluation of the Area (in degrees of suitability) for physical urban growth should be assessed separately for each of the three main "partial analysis" groups mentioned above. The first consideration concerns physiographic factors.

Based on planning implications obtained from



Map No. 48: Threshold Analysis—Natural Features

Key: 1. Land suitable for urban development (slope less than 1.0%; good load bearing capacity, low water table, etc.). 2. Land needing improvements before becoming suitable for urban development (land liable to flood, shallow peat, areas prone to landslides, slopes between 1.0% and 1.7%, areas of low load bearing capacity, rehabilitation areas, areas flooded areas, land liable to subsidence, etc.). 3. Land not suitable for urban development (marsh, swamps, salt marsh, steep peat, bogs, slopes steeper than 1.7%, land above 400 feet, commercial wharves in large bays, etc.)



Map No. 50: Threshold Analysis—Natural Drainage

Key: 1. Land suitable for urban development (areas with slopes under 1.0%; surface geology clay and alluvium and gravel areas). 2. Land needing improvements before becoming suitable for urban development (areas of poor natural drainage, boulder clay areas + poor soil fertility, B...-site-drain areas C—poor, D—non-available). 3. Land unsuitable for urban development (steep slopes (over 5.0%), peat, rock face areas adjoining rivers, land below 14' O.D., land liable to flood).

detailed direct surveys (see Physical Background), three categories of land were determined (see Map No. 49).

"Land unsuitable for urban development": All factors prevailing in this category undoubtedly create major obstacles for any type of construction. The necessary improvements needed to make such land suitable for urban development would be so costly as to make such decisions highly unlikely in at least the next twenty years. There may be doubts, however, about putting in this category all land above four hundred feet because of adverse climatic conditions. Reasons are fully explained in Chapter on Climate: planning implications. This point was treated flexibly; i.e., the barrier of the four hundred-foot contour was not considered as absolute, but was usually raised for southern slopes and lowered slightly for northern slopes. The reasons for putting woodlands in large blocks in this category were mainly economic. Areas of amenity and scenic value are not considered here, but are discussed fully in Research Studies.

"Land needing improvement before becoming suitable for urban development": This category grouped together all factors creating major but removable difficulties for town development. Improvements, though costly, would be commercially justified. The main factors were later quantified in financial terms to obtain possibilities for economic analyses (see Threshold Cost Assessment).

"Land immediately suitable for urban development": Automatically, the remainder of the land in the Area fell into this third category.

By defining these categories the "natural" growth potential and the "natural" threshold lines were established. The results obtained revealed the possible potential of the Area from this viewpoint only. The limitations for urban expansion were quite clear and the subdivision of land into the three categories neatly determined. The general characteristics revealed were that the first category mainly affected widespread areas, and the second, mainly smaller scattered areas which were later combined into larger groups, and some very small isolated pockets were then excluded as exerting only a marginal influence. The immediate conclusions from this first period analysis of natural features were that the limiting factors for overall urban growth potential of the Area are well defined and that without considerably increasing the applied gross densities rate (of twenty and thirty p.p.s.) the possibility for development in the post-1986 period will not be very great.

Limitations resulting from the analysis of natural drainage were also investigated, but appeared to have little significance for growth potential (see Map No. 50).

### Sewage Networks

Potential for urban growth is often strongly linked to the possibility of extending the existing sewage systems or treatment plants. It is also related to the degree of suitability of the land (due to its natural characteristics) for constructing entirely new collection systems, the catchment areas of which may delineate very clearly the possibilities of town development. Therefore, the main aim of the partial analysis of sewage networks in the Area was to consider these factors and to assess the possibilities of town expansion relative to sewage treatment problems. But this exercise the administrative boundaries of drainage catchment areas have been ignored.

"Land assessable for urban development": This was defined first of all and encompasses areas which could only be provided with drainage facilities at unreasonably high cost, and these should be excluded from further investigation as being completely unsuitable for building purposes.

"Land needing substantial capital investment before becoming suitable for urban development": Further complexities arise where substantial capital would be needed before some areas were valuable for urban development. Two types of land both concerning undeveloped areas requiring new trunk sewer networks were therefore distinguished as follows:

(a) land which could be conveniently incorporated with natural catchment areas of existing public utility networks. In this case, apart from topographical difficulties, the limiting factors may be determined by the existing capacity of the trunk sewers, thus creating certain quantitative limitations. If this happens new trunk sewers would be required to accommodate further urban growth;

(b) land within natural catchment areas having no public utility networks and therefore requiring entirely new systems. This mainly corresponded to drainage catchment areas and was confined to land not affected by previously defined negative factors.

The Local Authority have begun more detailed analyses into their future sewage networks, which may influence planning proposals. For that reason the boundaries of areas at present being studied by technical consultants have also been mapped.

"Land immediately suitable for urban development". The location of land in this category is of major importance for economically sound development programming during the next ten years or so. These areas are well defined and include all vacant land having existing sewage networks able to accommodate additional sewer flows without technical improvements; all areas with new systems now under construction and small pockets of land which can be serviced eventually by extending the local sewage system.

The last part of the study was undertaken to determine the capacity of existing and proposed treatment plants to define the so-called "Quantitative Threshold" figures within the limits of "Physical Thresholds" limiting the expansion of existing sewage networks. A number of new treatment plants to be installed were also taken into consideration. The situation here was fairly satisfactory as the ultimate capacity of existing treatment plants and those under construction exceeds the target population figures for 1986 and, as was later realized, more or less corresponded to the "Ultimate" Urban Growth Potential of the whole Area.

The results obtained have shown somewhat limited possibilities for expanding existing sewage networks, but a number of areas south of Falkirk, north of Denny, north of Larbert and round Alloa (the larger of these) were revealed where nothing prevented the construction of new widely dispersed sewage networks adequate to accommodate a considerable amount of new population. The detailed analysis of vacant land within existing urban areas has shown also a number of small pockets immediately suitable for development, information of particular importance for the process of implementation in the next 5-10 years.

### Existing Road Networks

Comprehensive investigations into the Area road problems and resultant implications for the final physical structure have already been fully considered in Phase One. In comparison, this study was



Map No. 57: Threshold Analysis—Sewerage

Key: 1. Land suitable for urban development (served by existing sewerage system). Land needing substantial capital investments before becoming suitable for urban development (2) and (3). 2. Within natural catchment areas being no sewerage system (convenient to construct new trunk sewer network). 3. Within natural catchment areas being no sewerage system (requiring actively new system). 4. Areas unsuitable for urban development (very steep slopes, peat, rock, land below 14' O.D., land liable to flooding, flat areas adjoining rivers, etc.) 5. Location of existing and estimated sewerage treatment plants. 6. Area within which sewerage schemes are being investigated. 7. Watercourse. 8. Directions of flow.

undertaken in a more limited way solely to discover the possibilities for further urban growth indicated by analysis of the accessibility in the existing road networks (i.e., their capacity and technical conditions and their "outfallment" areas).

"Land (essentially) suitable for urban development". The first problem was to define the land served by existing roads which fall into this category. In several traffic studies this type of analysis is based on very careful, comprehensive investigations into all the problems involved: width of roads, capacity, traffic in work flows, peak hour flows, technical conditions, etc. The method applied for Threshold Analysis aims to use a simplified technique in that a comprehensive analysis of all the main problems affecting town development possibilities may be obtained in a relatively short time. These principles are also observed in this partial analysis. Thus, the areas considered as having good access to the existing not overcrowded and technically good A, B and local roads were defined only in a crude way. These areas would not require extra capital road investments to make them sensible and they are thus suitable for building purposes. Assumptions were made determining the distance from various classes of roads, within which accessibility might be considered normal.

Up-to-date traffic studies are never simplified to such an extent and the only possible reference was to German theories of the early 'thirties, which defined zones of direct influence for various types of roads (see H. Sirk's "Wirtschaftlicher Studien und Grundzüge der Stadt"). Though this was a long

time ago, the theoretical basis was wide enough to provide a valid checking factor for the assumptions adopted, which initially derived from the definition of the possible length for a cul-de-sac (250 yards) and thus the zone of direct influence of local roads. The distance was finally settled as one-fifth of a mile on both sides of the road, and the distances for B and A class roads were proportionally larger (1 mile for B and ½ mile for A class roads). The final results related closely to the Sirk's theoretical formulation, and as the traffic conditions raised no major objections, these assumptions were adopted.

"Land unsuitable for urban development due to extreme technical difficulties and high cost of construction (no road)". This was allocated mainly on the basis of natural limitations.

"Land requiring new roads of primary or district disturbance standard before becoming suitable for development". The remainder of the land in the area will fall into this category, which shows areas in need of major road construction and also areas within the "zone of direct influence", but having roads at the limits of their capacity.

It should be mentioned that here the division of the main categories would not be defined so accurately as in the other partial analysis. Where divisions appear to be incongruous some modifications were allowed, based on direct analysis of selected areas. These usually concerned small pockets of land and their influence is too marginal to be discussed here.

### Existing Urban Structure

Areas of land or types of environment which could be developed, redeveloped or improved within existing built-up areas orburgh boundaries also offer opportunities for urban growth. The following types of areas can thus be defined as part of the process of determining urban development thresholds (see also Map No. 33).

#### 1. Redevelopment Areas

- Prepared:** Areas have been already designated as Comprehensive Development Areas (Bo'ness, Denny and Grangemouth) and Clearance Areas (Laudiston). The total area is 35.2 acres and their location is shown on Table No. 1.
- Possible Central Area Redevelopment:** This refers to large areas which have not yet been designated Comprehensive Development Areas or Clearance Areas and where negotiations are taking place on the development of shopping and central area facilities both by Local Authorities and private agencies. The only important example is at Falkirk (the Garrison Redevelopment area covering approximately five acres), which would displace only a small residential population. However, large redevelopment schemes may be expected in any part of the central areas whenever sufficient pressure builds up. This is likely to occur more often in the Growth Area in future.
- Possible Residential Area Redevelopment:** Information from the Environmental Assessment Survey has already shown areas of "poor environment" or areas of "fair environment not suitable for improvement", which indicate possible redevelopment areas. This category also includes areas liable to be designated for comprehensive redevelopment in future (e.g., at Camelon (20 and 20a)). Central areas where non-residential uses predominate are not included. Possible redevelopment areas in this category amount to a total of 374.4 acres.

#### 2. Rehabilitation Areas

- Rundown Environment:** The assessment of residential environment showed a number of areas in the lower ratings not necessarily ripe for redevelopment. Where these areas are likely to remain in the same use they could be improved to achieve a satisfactory environment.
- Land Improvement:** This includes areas (other than residential) of dereliction or neglect (e.g., former industrial sites, gravel pits, subsidence areas), undeveloped land unusable for urban functions without improvement (e.g., coast line and flats) and land used for depositing refuse and waste products (e.g., tips and barges). Two categories can be defined: *Prepared Areas* (i.e., already defined by Local Authorities) and *Possible Areas* (i.e., selected by observation and investigation as suitable for improvement).

TABLE 1: Redevelopment Areas

Burgh	Redevelopment Areas in Acres			Possible Other Redevelopment Areas		Total, including C.D.As and C.A.s	
	C.D.A.	C.A.	Location	Total Area	Location	Average	Population Displaced
Bo'ness	—	2.8	Laudiston Street Bridge and west end of Mary Street	20.1	Poldown Main Road Laudiston South Grahameyde Street (west end) P.O. Block Broughton P.O. Junction, W. Larne Park	22.9	532
Falkirk	11.4	—	Existing shopping centre by dock	26.2	Craighall, south of Main Street and Grangeburn and Ridgeway Road	67.6	3,118
Larkhall and Stenhousemuir	—	—	—	22.0	Larkhall Cross, Melville Street, King Street, Tyne Road	32.0	2,203
Denny and Dunipace	8.6	—	Existing shopping centre	23.4	Broad Street, Denny Bridge, Aven Bridge	31.0	835
Grangemouth	—	—	—	171.5	Gowrie, Williamson Square area, W. Bridge Street Caverside Main Street, Sunnyside Place (possible C.A.), east of Union Road (possible C.A.) Gowlinebank North Gethons Road, Waller Street area (possible C.A.), Thornhill Road Broughton Carron Road	171.5	5,545
Bo'ness	32.4	—	Existing shopping centre in Larney Street	33.2	Bo'ness Road, extension south and east of C.D.A.	45.6	2,747

Total possible Redevelopment Areas (including C.D.As and C.A.s) 430.6 acres

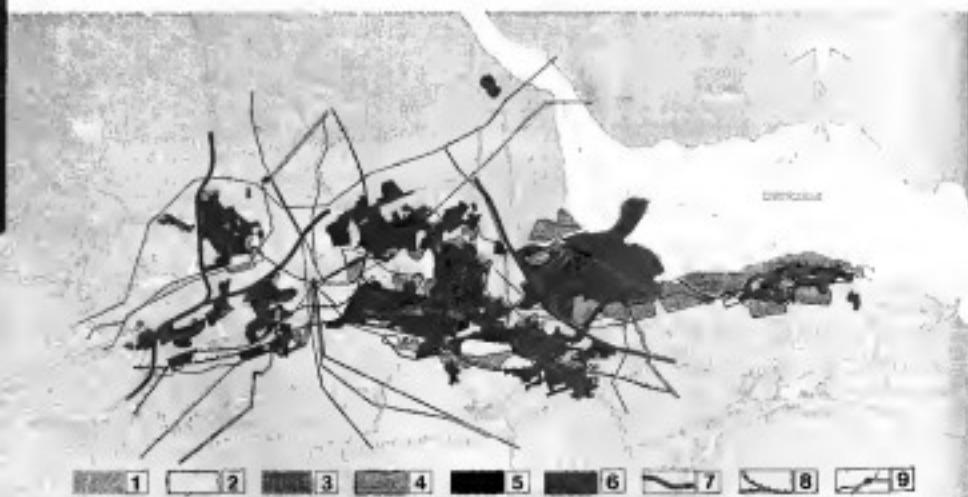
Total possible Population Displaced (excluding C.D.As and C.A.s) 14,075

Total average displacement density 34.0 p.p.a.



Map No. 52: Threshold Analysis—Existing Roads Network

Key: 1. Unclassified road; 2. B-class road; 3. A-class road; 4. Congested sections of roads; 5. Areas where accessibility is affected by congestion on A-class roads; 6. Land suitable for urban development (areas served by existing roads); 7. Land requiring new roads of primary or district distributor standard before becoming suitable for urban development; 8. Land unsuitable for urban development due to extreme technical difficulties and high costs of constructing new roads.



Map No. 53: Threshold Analysis—Existing Urban Structure

Within Borough Boundaries and built up areas:  
 Areas suitable for urban development; 2. Areas already used for urban functions; 3. Undeveloped Areas and Clearance Areas; 4. Committed and possible Comprehensive Development Areas and Clearance Areas; 5. Possible Residential Area Rehabilitation; 6. Areas not suitable for urban development; 9. Built-up areas generally to remain in the same use Within Growth Areas;  
 Superimposed (without impure dentation on urban expansion); 7. Roads (dotted convergencies); 8. Railways;  
 8. Overhead/High tension cables.

### 3. Undeveloped Land

- Areas already used: Some areas of agricultural land have already been defined in Development Plans for urban functions.
- Non-used areas: This covers agricultural land (withinburgh boundaries or built-up areas) not yet defined in Development Plans for urban functions.

### 4. Suprastructure

To complete the analysis of existing urban structures and to define the development threshold lines additional factors had to be considered. These were based on the major infrastructure lines which might create limitations for further town growth. They were: railway lines and overhead cables and motorways.

The subdivision of the areas 1, 2, 3 can now be put into the same three categories as in the first "Partial Analysis".

"Areas immediately suitable for urban development": This category will then include both types of undeveloped land (3a, b) usually found in the form of small pockets within existing built-up areas or directly adjacent to them. The acreage of these areas did not reveal any substantial growth potential, but they are important since they have the highest degree of suitability for development for the Area as a whole.

"Land needing improvement before becoming suitable for urban development": This category comprised all areas having considerable growth potential. These were all Redundant Areas (1a, b, c) and derelict or neglected land (2b) requiring improvement for building purposes.

"Land unsuitable for urban development": This category referred to built-up areas which would generally remain in the same use. These areas may be subject to special environmental restrictions or environmental conditions, or may have possibilities for improvement and thus possibly continue to carry out their present functions (2b).

Those areas so defined as having growth potential will nevertheless be subject to some principles of suitability for urban functions set out in the "Growth Potential Study 1st Stage". Special attention will also be paid to the influences of existing land uses and regional policies for the settlement. The potential of redeveloped residential areas in particular will be governed by the extent to which population can be relocated in the same areas. The "population potential" can therefore be indicated as a plus or minus value of the original number of inhabitants of the area. The population was calculated for redevelopment areas by using information from the previous studies, and the results are shown in the Table. Some 14,000 persons might be displaced in the main urban areas if the total possible and proposed redevelopment areas (410.6 acres) were redeveloped. However, these areas may not all be required for housing development in the proposals more improved recreation facilities, schools, new roads and re-alignments may be expected to need more space in urban areas than before, and in central areas shops and office development will probably have priority. Therefore, to rehouse the displaced population as possible re-

development areas, densities may need to be greatly increased.

All these areas of growth potential will form the basis of ACTION areas, on which attention will be focused during the early stages of implementing the Plan. They will affect the planning and phasing of new development.

### Definition of Threshold Lines

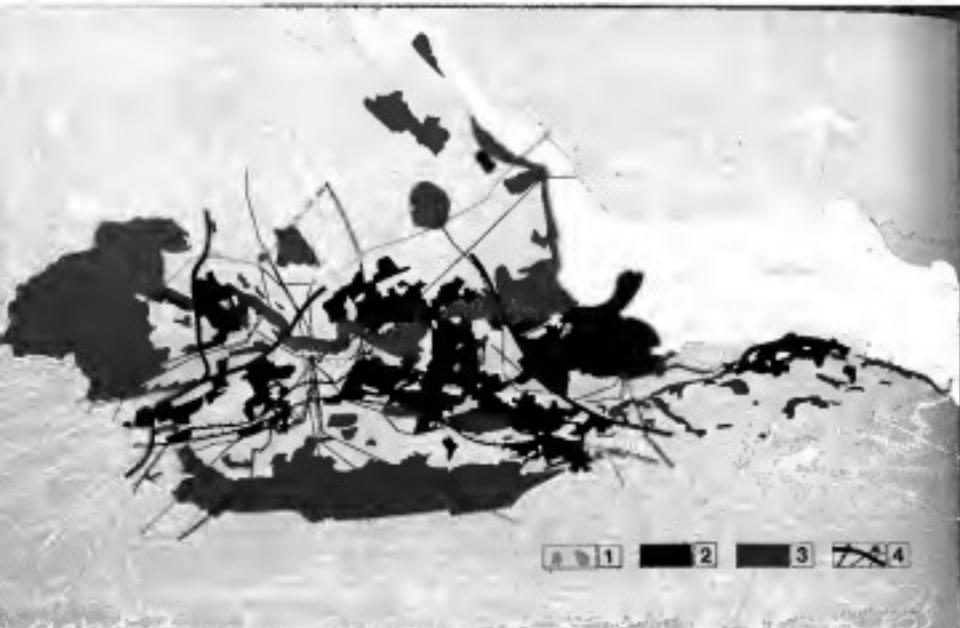
Before the final definition of threshold lines two further steps were necessary. First, all land unsuitable for development, from all groups considered, was eliminated from further analysis and the main existing linear limitations for spatial urban expansion were indicated (see Map No. 54). Secondly, the best areas were defined, that is, those immediately suitable for urban development from the viewpoint of all partial analysis within all groups involved (see Map No. 55).

The successive threshold lines were then drawn (see Map No. 55). These lines defined mostly homogeneous areas within which the additional per capita costs of the location of the new inhabitants were for the most part similar. 1st, 2nd, 3rd and Ultimate Thresholds were shown.

By the definition of threshold lines the implications of existing conditions have been indicated and form the basis of the next stages of the planning process. However, it is worth stressing that threshold lines even by themselves form some sort of "Solutions Plan", resulting from an objective and analytical process. As such, they provide a necessary framework for the Research Studies, permitting the consideration of the various hypotheses for the Area's structure within fairly well defined physical limitations. The most important is the Ultimate Threshold (or "Regional Threshold") which defines the line beyond which further physical expansion of the Growth Area is highly unlikely. A tendency for stabilisation will therefore appear. This is of particular importance when dealing with long-range analyses and predictions.

### Calculation of Growth Potential

The next step towards calculation of overall growth potential was the sub-division of land within threshold areas for two uses: uses only, areas suitable for industry and areas suitable for residential and other functions (see Map 57). This has been mainly based on the Industrial analysis already completed. As demonstrated, the importance andifiability of the location of industry demands priority for this function. Information from the urban models (Model 7 in particular) was also taken into consideration. The last result obtained from the physical approach of threshold analysis was the calculation of the capacity of residential areas and industrial acreages within the 1st, 2nd and 3rd threshold lines (see Table No. 2: "Calculation and Distribution of Urban Growth Potential"). This was based on urban standards defined by environmental research into optimum densities, which should be applied to this Area. Thus, the gross densities of 30 p.p.a. for the 1st and 20 p.p.a. for the 2nd and 3rd thresholds were used and the growth potential was calculated. (See also the Table on Threshold Costs Assessment in the following chapter).



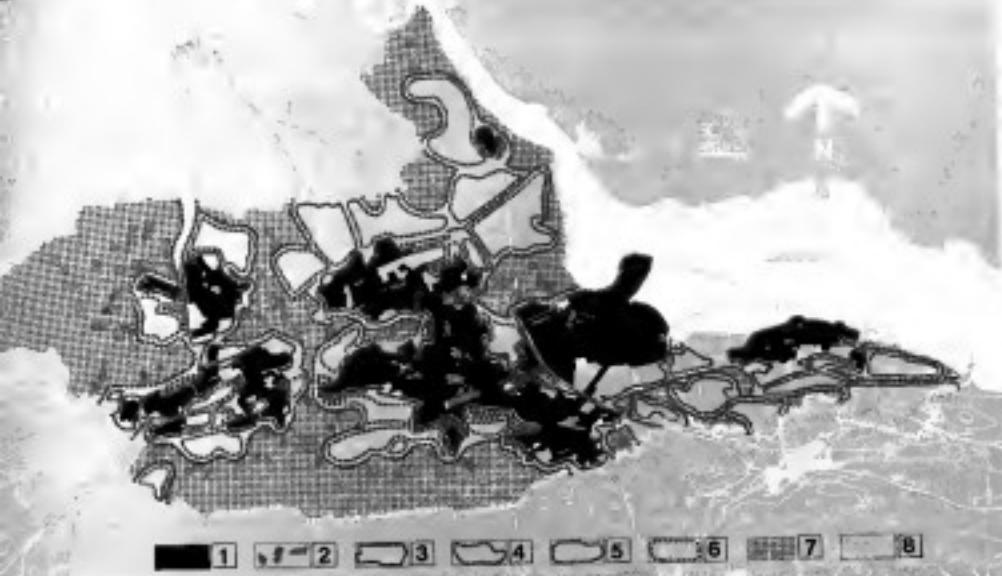
Map No. 84: Threshold Analysis—Partial Synthesis (1)

Key: 1. Areas unsuitable for urban development. 2. Existing built-up areas. 3. Other areas unsuitable for urban development. 4. Superstructure impeding investments in urban expansion.



Map No. 85: Threshold Analysis—Partial Synthesis (2)

Key: 1. Areas suitable for urban development (including some areas of poor natural drainage and short with respect to accessibility).



**Map No. 56: Threshold Analysis—Floor Synthesis**

Key: 1. Existing urban areas. 2. Areas requiring urban renewal and areas zoned for urban frontlines. 3. 1st threshold line—separating existing urban areas and land suitable for urban development. 4. 2nd threshold line—containing land requiring minimal requirements involving substantial capital/investment before it is suitable for urban development. 5. 3rd threshold line—containing land as defined in 2nd Threshold but which is an isolated location. 6. Ultimate threshold line—containing land unsuitable for urban development. 7. Areas within Ultimate Threshold Line. 8. Areas of isolated and/or irregular shape which are considered unsuitable for building purposes.



**Map No. 57: Threshold Analysis—Urban Growth Potential**

Key: 1. Areas within First Threshold (101-187). 2. Areas within Second Threshold (201-227). 3. Areas within Third Threshold (301-308). 4. Land more suitable for Industry. 5. Land more suitable for Residential and Ancillary uses.

Note: For details of the areas and their potential population refer to Table 2.

TABLE 2

*Calculation and Distribution of Urban Growth Potential**A. RESIDENTIAL AVERAGES*

	1st Threshold	2nd Threshold	3rd Threshold	
Bonnybridge	15 15 30 10 10 30 5 35 5 5			
Denny	150 150	130	—	
Larbert	5 60 80 25 30			
Falkirk	230 180 100 600 675 325			
Airth	—	—	800	29,000 21,900
Locheehead				
Redding				
Westquarter				
Polmont	14,000	11,400	8,400	16,200 30,000
Gourock	30,000	5,700	—	— 25,300
Boness	14,000	11,400	8,400	16,200 30,000
Totals:	124,000	33,850	29,800	48,000 313,850
Larbert	5 60 280 30 10 15 5 35			
Falkirk	70 35 40 10 115 30 10 5			
Airth	—	40	950	
Polmont	40 30 50 70 35 5 15 5 10			
Gourock	40 150 190 190	160	—	
Boness	10 260 140 100 30	280 140 350 430 430	960 310 310	
Totals	1,795	4,650	2,800	

*B. GROWTH POTENTIAL POPULATION*

	1st Threshold (20 p.p.a.)	2nd Threshold (20 p.p.a.)	3rd Threshold (20 p.p.a.)	Total
Bonnybridge	—	4,300	2,300	— 17,700
Denny	6,450	11,600	6,800	33,850
Larbert	13,900	42,800	— 75,800	
Falkirk	5,100	25,800	— 68,400	
Airth	— 800	29,000	21,900	
Locheehead	— 1,800	3,200	— 24,000	
Redding	— 13,000			
Westquarter	— 1,800			
Polmont	— 13,000			
Gourock	— 5,700	— —	— —	25,300
Boness	— 11,400	8,400	16,200 30,000	
Totals:	53,850	93,800	48,000 313,850	
C. INDUSTRIAL AVERAGES				
	1st Threshold	2nd Threshold	3rd Threshold	Total
Bonnybridge	80 130 20 45 45	280 75 10 320 320	— — — 715 715	— — — 1,220 1,220
Denny	10 40 80 120	— — — —	— — — —	— — — 130
Larbert	50	— —	— —	— 50
Falkirk	— —	60 240 470 750	— — — 750	— — — 150
Polmont	50 5 40 75	— — — 70	— — — —	— — — 145
Gourock	25 370	— —	— —	— —
Boness	385 385	230 —	— —	— 615
Skinflats	— —	1,000 —	— —	— 1,000
Airth	— 580	— —	— —	— 580
Totals	985	3,345	320	6,650

### D. GROSS TOTALS

#### 1. Residential Population:

Existing	124,000
1st and 2nd Threshold	347,600
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Total	271,600
3rd Threshold	42,000
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Gross Total	313,600

#### 2. Industrial Area/pop:

Existing	1,000
1st and 2nd Threshold	4,500
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Total	6,200
3rd Threshold	300
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Gross Total	6,500

The results indicated the overall Urban Growth Potential on the basis of three average gross density standards and predetermined industrial location policies. Combined with the Ultimate Threshold line, it produced the Ultimate Growth Potential. It is obvious that the decision to expand the Area's growth beyond its limit is both unlikely and highly undesirable, mainly for economic reasons; in any case, such a decision could be undertaken only at governmental level. It was therefore considered unnecessary to analyse these remote and very uncertain future possibilities.

The total possibilities for accommodating new population within successive threshold lines for all settlements (towns and villages) involved were then as follows:

1st Threshold	53,800
2nd Threshold	93,800
3rd Threshold	42,000
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Ultimate Threshold (cont)	189,600

Similarly, the possibilities for new industrial locations have been calculated as follows:

1st Threshold	965 acres
2nd Threshold	3,345 acres
3rd Threshold	320 acres
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Ultimate Threshold (cont)	4,620 acres

The existing population in 1965 was about 124,000, so for purposes of expansion (i.e., excluding problems of urban redevelopment and renewal) the Ultimate Growth Potential for the Area was defined as approximately 310,000 population.

It is worth bearing in mind that alterations to these figures might be produced by varying urban density standards or the acreage allocated for industry. However, so far these seem well founded and the figures obtained have become the basis for further stages of the analysis, which was to investigate certain economic aspects of the Growth Potential for the Area.

## 2. Threshold Cost Assessment

### PRINCIPLES

#### Definition of Threshold Cost

It is clear that the need to overcome a threshold line of a given area results in a very substantial rise in the infrastructural costs which are heavily bound to the existing conditions and characteristics of that area. On overstepping the threshold, i.e. completing all investments necessary to open this area for town expansion, there is a decline in those costs.

This concept, particularly striking in the analysis of "per capita" costs, may be expressed diagrammatically:

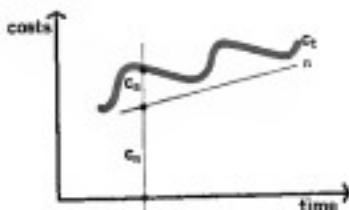


Diagram IV: Threshold Costs Curve

Where  $C_n$  are the normal investment costs not connected with a given location, and  $C_a$  are the additional investment costs heavily bound to existing conditions and characteristics of a given area, then  $C_t$  are the total investment costs necessary to locate a new inhabitant on that given area, i.e.  $C_t = C_n + C_a$ .

The line "n" expresses normal investment costs. The peaks on  $C_t$  represent the "Thresholds" as they occur on the per capita costs curve.

It is not proposed to go into more detail here as the problem is complex. Broadly, the Threshold Costs are the variable costs ( $C_a$ ) necessary to overcome the thresholds limiting the physical urban development (of a village, a town, a sub-region, etc.).

#### Aims

The general aims of economic assessment of overall Growth Potential (obtained as a result of Threshold Analysis, and by defining the suitability of undeveloped land for the main functions) were:

- to show the rational and economically sound sequence in which adjacent areas suitable for urban expansion should be developed better, i.e. specifying the best return for expenditure, and the greatest economic potential;
- to enable the construction and comparison of various possible hypotheses and thus to help choose the "optimum" for the final Development Model;
- to become the cost-base for this new type of analysis as a contribution towards research into the optimisation of planning methods.

It was proposed that the above aims would be achieved by calculating cost indices showing additional per capita costs necessary for the location of each new inhabitant within respective threshold areas, which are determined by the unavoidable extra capital expenditure needed in opening land for building purposes in any of the threshold areas involved.

## APPLICATION OF THE METHOD

To enable this type of analysis to be done in a relatively short time the following basic assumptions were made.

- 1 To analyse only the threshold areas designated for residential functions. This was assumed, because the main interest of the analysis was the cost of locating new inhabitants, and because most of the location of industry had already been decided.
- 2 To eliminate from the calculations all areas beyond the unknown threshold line.
- 3 To take into account only two standards for the average gross density. These were decided on as a result of detailed environmental research into the Area's future urban structure, and were twenty and thirty persons per acre respectively.

After broadly analysing the characteristics of the additional (or "Threshold") costs which would be involved, it was proposed to distinguish three main groups of costs for further calculations.

### First Group

Cost connected with adaptation of land for building purposes (based on physiographical factors)

Various factors within this group may create a substantial increase in the costs of construction, e.g. by raising the direct building costs of housing, public utility networks, or roads; by requiring special additional investments to make given land suitable for building purposes; by imposing limitations for residential densities; by necessitating the improvement of local climatic conditions, etc.

From the results of detailed investigations the following per capita costs were calculated:

- additional costs involved by construction on slopes (more than 1:6, 1:12 to 1:18 and 1:20 to 1:40) in comparison with construction on the level;
- additional costs required to prepare wooded areas for building purposes;
- additional costs of foundations on shallow peat bogs or on land with limited bearing capacity (piling, setting). These were not considered further, however, since most of the future residential development is to be 2-3 storey houses, which do not have serious foundation problems.

### Second Group

Costs of acquisition of land and/or its reclamation

Various costs may be involved within this group e.g., direct costs to be paid to the owner; indirect costs (imported at the regional and national level) connected with changing the existing use of land, thus decreasing agricultural or other productivity; costs involved in necessary relocation of existing land uses; rehabilitation costs for land detrimentally affected by different activities (quarrying—mining, etc.); compensation for various rights affecting some areas, etc.

From this group the following per capita costs have been calculated:

- the market prices per acre for all analysed areas (excluding land owned by local authorities, the acquisition cost of which was taken as 0);
- the compensation to the National Coal Board;
- the cost of rehabilitating derelict areas.

### Third Group

Costs connected with construction of various public utility networks and roads

The following main examples may be enumerated within this group: the costs of main lines of public utilities (mainly dependent on the distance from main sources of supply, or from treatment plants); the costs of major new roads to be constructed to provide direct access to respective areas. The following items were calculated within this group to obtain per capita costs indices:

- the costs of laying new trunk collectors according to their length and diameter, calculated in relation to the population to be served and the slope of the land;
- the costs of expanding the existing sewage treatment plant based on recent estimates;
- the costs of constructing new treatment plants in relation to the assumed capacity;
- the costs of constructing various new roads (primary and district distributions);
- the costs of constructing new bridges, tunnels, etc.

On this basis, all assumed indices were calculated and presented in the form of one matrix, including all items considered for all analysed threshold areas (see Table No. 1 and Map No. 50). In addition, a diagram was prepared to indicate the comparative additional costs of development of the main town groups in the Growth Area on the basis of Threshold Cost Analysis (see Diagram No. V).

It should be noted that owing to lack of certain information it was not possible to take into account some important costs connected with the essential reclamation of land affected by past mining activities. Only a superficial analysis was carried out and this revealed that no overwhelming difficulties would arise providing sites are investigated before development.

## CONCLUSIONS

The conclusions were based on the integration of the results of all analyses (i.e. Growth Potential—First Sieve, Urban Growth Potential and Threshold Cost Assessment). So the final working synthesis obtained was an objective basis for the next stage of the planning process. The results from the simplified Threshold Analysis appeared to be moving towards two linked but separate conclusions.

- 1 The first reveals an objective, quantitative basis upon which choice may be made between alternative areas of development making it possible to eliminate the high cost areas. The main implications were thus obtained to help successively in:
  - determination of the scale of development in the Grangemouth/Falkirk Growth Area;
  - definition of long-term directions of urban growth within the Growth Area;
  - construction of the final Development Model in the planning process resulting from integration of the results of all research (i.e., Data and Analytical Studies, Research Studies and the Socio-Economic Studies of our colleagues).
- 2 The second is concerned with the programming of public investment. A great deal of the threshold expenditure must precede exploitation of the area, thus in the development of an area there is an initial "hang" investment before even one house is completed. The analysis clearly distinguishes two types of areas suitable for development: first, small intra-threshold pockets and second, larger extra-threshold areas. The former

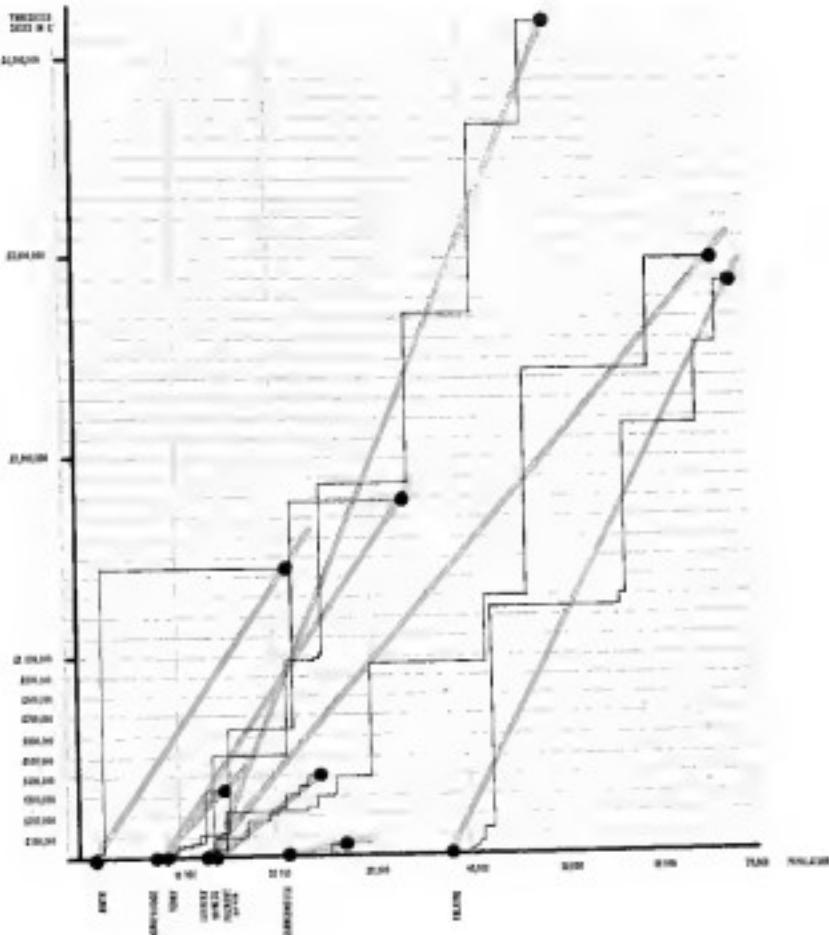


Diagram V: Threshold Costs—Comparison

category is much more flexible than the latter in that they can be developed quickly and cheaply. It is desirable therefore, to use these packets in circumstances which will exploit their flexibility; for example, they could be developed to allow a more rapid start to the build-up in the Area than would be possible in the case of a major development. Alternatively, they could be used to provide feasibility in the programme at later stages.

The Matrix outlining Total Additional Development (or "Threshold") Costs makes it clear that the areas within the first threshold are much cheaper to develop. They should undoubtedly be used, although for reasons outlined in the last paragraph there is no necessity to develop all of them first. These areas, however, are generally small, more in the form of "packets" or undeveloped corners of existing urban areas (although some are quite sizeable). It is known that even to accommodate the natural increase in the Grangemouth/Falkirk Area

these areas must be developed. The real comparison comes after exploitation of the first threshold areas.

The obvious programme is to develop the cheapest areas to provide for the proposed population. However, some points should be made:

- The aim for the Growth Area ought to be fed into an assessment of the comparative costs of development in various parts of Scotland. The national integration of region-wide and local policy formulation in this way seems to be one of the main properties of this technique.
- Some areas may not be suitable for development until others have been built up, e.g. it would appear undesirable to develop the Ayrshire area until after Larbert, otherwise there is some danger of creating little "islands" and not an integrated urban area.
- Related to the last point, it may be desirable not to spread development too thinly if the Area is to act as a growth point.

Map No. 5a: Threshold Criteria—Space-time and Allocation  
Key: 1. Main Town Groups—Subdivision of Townland Coasts (for one year in advance). 2. Up to £20. 3. £100—£100. 4. £200—£200. 5. £1000—£1000 & Over £2000.  
Note: See details right in Table 1.



## 240 Threshold Areas

Areas For D348	149	184	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	Totals
Areas Anti- ID	89	89	220			59				45	45	18		12	3					193
Area D-36				3	36		5	28	3				30			30	18	13	30	1,210
Popul. at p100				132	1,000		150	400	150				300			300	600	400	600	30,820
Yield above Avg.	*	*				*	*	*					*			*	*	*	*	
Sem- 16	—	—				—	—	—					—			—	—	—	—	
—	—	—				—	—	—					—			—	—	—	—	
Non- Lan-	—	—				—	—	—					—			—	—	—	—	
Top D-1	—	—				—	—	—					—			—	—	—	—	
Mid C-1	—	—				—	—	—					—			—	—	—	—	
Wor P-1	—	—				—	—	—					—			—	—	—	—	
Total = 7	*					*	*	*					*			*	*	*	*	—
																				*
																				—
																				—
Change Costs			2,000	35,000		1,000	3,000	1,000					2,000			3,000	3,000	3,000	3,000	370,000

KEY: \* Consistent — Cons do not appear ■ Consistent consistent

#### *To HIGHER net figure*

- Shortage of land or desire to conserve best quality agricultural land
  - High initial cost of land
  - Subsoil of high bearing capacity
  - Areas of high cost foundations, due to mining
  - Choice of or nearness to District shopping facilities
  - Nearness to public transport belt (linking with Regional Centre facilities)
  - Maximum utilisation of existing infrastructure
  - High total threshold costs
- In view of the extent of past mining activities, detailed investigation will be necessary in all areas since pockets of differing densities may be desirable, i.e., multi-storey development within generally low density areas.

#### **Conclusions**

By using these factors some residential areas zoned in Model 7 were clearly defined as most suitable for the following variations in density:

*Higher Density:* Areas at Borrowstoun (south of Bo'ness), areas at Greenbank (south of Falkirk), Bowhouse (Grangemouth), all redevelopment areas adjacent to District and Regional Shopping Centres.

*Lower Densities:* Areas north of Carronshore, areas south of Glenbervie Golf Course, areas east of Denny.

## **INDUSTRY**

Continuous progress in technology such as mechanisation and automation of production processes (allied with the growing demands for shorter working hours, and increased parking requirements), will contribute to a decrease in the future intensity of development in the majority of manufacturing industries. This is confirmed in recent industrial development in Scotland (particularly in 'heavy, capital-intensive industry'), where the average ratio of workers per acre is decreasing. In Livingston for instance forty w.p.a. was taken as the design figure for gross densities, but so far the industries attracted have only averaged twenty w.p.a. In Grangemouth/Falkirk Growth Area the average gross density is already low, especially in areas likely to be expanded by major industries in the next twenty years. In Grangemouth the existing average employment density is five w.p.a.; in Bonnybridge thirteen w.p.a. and in Falkirk nineteen w.p.a.

Though it is not possible to determine precisely the types of industry which will come to the Area these are likely to be industries such as: petrochemicals, timber works, chemical works and other highly automated and capital intensive industries all of which have low employment densities. Higher

employment densities will mainly be found in light industries such as electronics, clothing, service industries and manufacturing concerns which are closely related to central areas. A generous acreage of land will need to be reserved for industrial development to allow an essential measure of flexibility to the proposed physical structure of the Growth Area, even if the density ratio is higher in the course of implementation. This will ensure a choice of industrial sites which will both help to attract industrial developers, and make it easier for the Authorities to satisfy their various requirements, and may allow for some post-1986 expansion.

Excluding service industries, densities will probably vary from five w.p.a. (mainly petro-chemical) to twenty-five w.p.a. (metals, etc.). Thus a reasonable average employment density for new industrial sites is taken to be ten w.p.a. for the Growth Area. Some sites may attract industries with widely varying densities around this average and (as in the foregoing section on residential development) various factors can also be examined which may be expected to influence the intensity of industrial development as follows:

#### *To LOWER net figure:*

- Proximity to appropriate natural resources
- Good communications, by road, rail or sea
- Extensive water supplies

Large flat sites

Locations which allow the dispersal of airborne wastes and/or reasonable distance from residential areas (in the case of noxious industries)

Areas of poor bearing capacity or future coal extraction (in the case of capital intensive industries)

#### *To HIGHER net figure:*

Smaller sites or shortage of land suitable for industry

Difficult gradients

Short journeys to work

Desire to employ maximum number of workers locally

Desire to employ large numbers of female workers

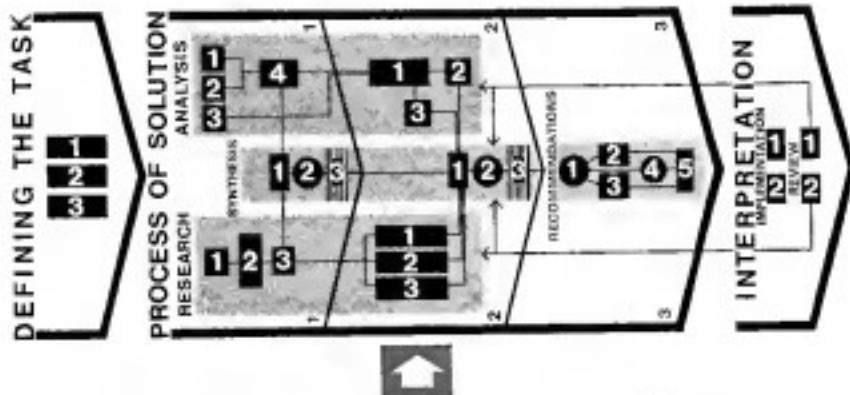
Areas of extensive past mine workings

#### **Conclusions**

By using these factors, areas defined in Model 7 for industrial development can be examined in more detail and might be expected to attract variations in intensities of industrial development as follows:

*Higher Density:* Small areas at Bonnybridge, smaller sites close to existing urban areas, such as Denny, Lochlands (Falkirk), Bo'ness.

*Lower Densities:* The major part of the Bonnybridge site, Skinflats (very low), Wholefloss (Grangemouth).



## Research Studies: Possible Development Patterns

### 1. TOWARDS AN IDEAL URBAN ENVIRONMENT

RESIDENTIAL AREAS: Assumptions on car ownership—basic unit concept

COMMUNITY FACILITIES: shopping catchments based on residential basic units—shopping hierarchy—education—welfare and social facilities

ENVIRONMENTAL AREAS: Definition—community structure analysis

REVITALISATION OF EXISTING RESIDENTIAL ENVIRONMENT: possible solutions—implications of environmental ratings

### 2. TOWARDS AN ACCEPTABLE COMMUNICATIONS NETWORK

TRANSPORTATION ADVISORY GROUP: Terms of reference

TRAFFIC PRINCIPLES AND ROADS HIERARCHY: Based on national, regional, district and local scales

HYPOTHETICAL ROAD SYSTEMS: Possibilities and analysis of radial, spine and ribbon, hexagonal systems

POLICY ASSUMPTIONS FOR CALCULATING THE TRAFFIC: Traffic—car ownership—public transport—off-peak travel—car usage—bus capacity—modal split—peak hour

SCOPE OF THE TRANSPORTATION STUDY: Trip distribution—traffic synthesis

### 3. TOWARDS A FEASIBLE RECREATIONAL SYSTEM

PRINCIPLES: Suitability—attractability—flexibility—exploitability—capability—extensibility

RECREATIONAL COMPONENTS: Types of parks—children's—local—district—regional greenway system

The Section on Urban Environment describes the factors which led to the evaluation of the basic unit as the residential module, and discusses its implications on the provision of community facilities, and environmental quality. Methods to

relate the Environmental Assessment to the improvement of the existing residential environment are investigated.

The communication studies were principally concerned with road traffic. They established the

relative functions, scales, components and principles of all the systems involved. A number of hypothetical solutions based on stated assumptions were developed, tested and evaluated. The chosen optimum solution was again tested with the more detailed proposals incorporated in Model 7. This was followed by further reallocations of land use before the final recalculation of traffic flows.

The section on recreation was concerned with establishing a working system commensurate with the present and future needs and the natural features and advantages. Standards were evolved which were relevant to the residential basic unit concept; and a regional greenway system was developed with inter-regional links.

## Research Studies: Possible Development Patterns

### 1. Towards an Ideal Urban Environment

From the first designs for new towns and cities it has been the aim to achieve the best possible living conditions for the inhabitants. Substantial increases of population have allowed the investigation of new urban structures, and more recently, through the New Towns Act, this opportunity has been exploited in Great Britain. The controlled expansion of urban areas on a large scale also offers opportunities in the design of residential areas to satisfy the demands for a "good environment", providing not only satisfactory housing but also adequate community facilities. At the same time there can be a re-appraisal of the existing residential areas to assess their suitability for "revitalisation". A technique has been devised for producing an urban structure which will aim towards achieving an ideal urban environment.

#### Residential Areas

The findings of the study assessing residential environment emphasised the amorphous quality of existing housing areas and their lack of an urban framework. It is therefore desirable to create residential groupings which would enable environmental considerations to have more effect, whilst fully exploiting existing facilities. Although total separation of traffic and pedestrians is not required or physically possible in many existing areas, there is still the need and the opportunity to minimise pedestrian/vehicular conflict.

Some recent traffic engineering studies point towards the solution. The "Northampton, Bedford and North Bucks Study" (MOHLG 1965) defined a theoretical residential unit of population having frontage development on roads, but achieving acceptable peak traffic flows for a given density and car usage, as follows:

300 v.p.h. at 50 per cent usage for work journeys  
— 600 cars owned.

600 cars at 1.2 cars per family = 500 families.  
500 families at 3.5 persons per family = 1,750 population.

1,750 unit of population at 50 persons per acre =  
35 acres.

These assumptions of car ownership and car usage are similar to those made by the Traffic Advisory Group for this Area. The Buchanan Report "Traffic in Towns" (1963) gives a useful check on these traffic volumes in Appendix I dealing with "Environmental Capacity of Streets". This shows that with traffic volumes of 300 p.c.u.s/hr. on an eighteen-foot road the average delay to all pedestrians is less than two seconds, and the percentage delayed is below fifty, giving figures acceptable on environmental grounds. (For residential areas the figure of p.c.u.s has been taken to equal v.p.h.). Another study

carried out by the Newcastle City Planning Office, "Environment and Communications", concluded that an environmental unit defined for traffic purposes will have between one thousand and two thousand five hundred inhabitants and be made up of small groups of from two hundred to three hundred dwellings, each having access from the secondary road system, with traffic volumes of between one hundred-and-twenty and one hundred-and-thirty v.p.h. The report suggests that this population range may serve successfully as the basis of social planning, with provision for a corner shop and play space in each unit.

Thus, on traffic grounds alone there is a need for a smaller, more flexible planning unit in the urban structure than the concept of "neighbourhoods" of ten thousand minimum population. As part of the planning technique for rationalising the urban structure, the existing residential districts in the Area were therefore graphically sub-divided into Basic Units of approximately 1,750 persons. The area of each Unit varied with the density and was based on the 1961 population census figures and information gained from the Housing Survey. Series of Units were built up which could in theory be served by eighteen-foot wide carriageways if extraneous traffic was excluded. Traffic could then be canalised to ensure that pedestrian/vehicular conflict was controlled, allowing the collector roads in residential areas to be easily crossed by pedestrians, and the development of separate pedestrian routes to be a feasible proposition.

This Basic Unit was then used as an elementary component for new residential areas. Natural features such as gradients, vegetation, orientation, altitude, landscape type and local climate, and the existing road patterns influenced both the intensity of development and the disposition of the Basic Units (see Diagram No. VI).

#### Community Facilities

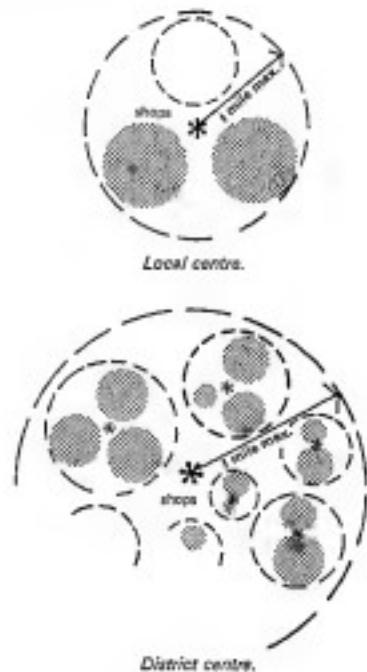
It was considered that the Basic Units could also relate to the provision of community facilities such as shopping, education, welfare and social facilities. Wherever possible, locations should permit multi-purpose journeys (e.g., to schools and shops).

#### Shopping

In accordance with the development objectives, settlements would not be completely self-contained, but would focus on Falkirk as the main regional commercial centre. To ensure an even distribution of catchment populations or hinterlands an hierarchy of shopping centres would be built up from the simplest facilities within housing areas to the largest

centre at Falkirk, based on the hierarchy of catchment populations outlined in Volume One, Chapter 5.

These catchment populations can be divided into Basic Units of 1,750 population for both existing and new development. At the simplest level, a local shopping group would be supported by 3,000-5,000 people, so that the simplest shopping Catchment Unit can be defined as two to three Basic Units. Likewise, the district centre would be supported by a minimum of nine Basic Units and the regional centre a minimum of eighty-six Basic Units. The relationship of Basic Units and shopping centres is shown in Diagram No. VI.



*Diagram VI: Shopping Catchments*

The physical distribution of centres must be convenient for their catchment populations in terms of accessibility either by foot or by public and private transport. The acceptable journey distance is taken as the radius from the shopping centre and will vary according to the attraction of the facilities available. Local centres offering only convenience goods

should be within a short walking time of residential areas and located at the meeting point of greenways. District centres offering a wider range of goods must not only be accessible to pedestrians but also located adjacent to district or local distributor roads with associated bus stops and parking facilities. The regional centre offering mainly durable goods must be easily accessible by bus and car, but road networks and land availability would be unlikely to permit unrestricted parking, therefore journeys by public transport must be made an attractive proposition and should not exceed fifteen minutes, including walking time to the bus stop. The regional and district centres will also act as local centres for their immediate catchment populations. Likewise, Falkirk Centre will also act as a district centre.

The theoretical hierarchy of shopping centres incorporating all these factors is shown in Table I.

In existing residential areas established groups of shops which will continue to give adequate service would be incorporated, and opportunities should be taken to improve the shopping environment during redevelopment or property improvements. New centres must be located to give as large a catchment as possible within the maximum walking distance.

#### *Education*

The distribution of education facilities would be directly related to the distribution of Basic Units. However, the time/distance factor, so important for the primary school population (maximum desirable walking time is seven minutes or three-eighths of a mile), cannot apply to senior secondary schools nor to Roman Catholic schools, since their catchment populations are more widely scattered. It is important therefore that these institutions should be located near a bus route. All playing fields should be integrated into the open space network. The school catchments can be defined as follows: one nursery school per two to three Basic Units; four primary schools and one senior secondary school per eight Basic Units.

To accommodate the Roman Catholic school population, one out of every four primary schools and one out of every three secondary schools would be Roman Catholic. Although new primary schools will be based on a capacity of approximately five hundred pupils, some good existing primary schools take six hundred pupils and others around two hundred and fifty, so variations may occur. One nursery school per Catchment Unit should be sufficient in the early stages of the Plan, preferably located close to the primary school site.

*TABLE I: Shopping Centres: Model Hierarchy*

Type of centre	Approx. min. catchment pop.	Population as no. of Basic Units	Walking* distance/time	Access orientated	Range of facilities
Regional	150,000	86	1 mile/20 mins.	Public transport mainly, and car (15+ mins. journey)	Good choice of durable and some convenience goods
District	15,000	9	1½ miles/15 mins.	Car mainly, and public transport (15 mins. journey)	Good choice of convenience goods, limited range of durables
Local	3,000-5,000	2-3	1 mile/5 mins.	Pedestrians	Limited choice of convenience goods

\* Based on walking speed of 3 m.p.h.

## Welfare and Social Facilities

The proposed shopping hierarchy will have a strong influence on the location of welfare and other social facilities because their catchment populations will be similar. Some facilities would be attached to local shopping centres, but some may be scattered throughout the Basic Units because they acquire a special identity of their own (e.g., public houses, churches), but should be located on the greenway network. The size of catchment populations justifies some community buildings being located in the district shopping centres catering for administrative, entertainment and welfare needs (see Volume One, Chapters 5 and 9). In the larger centres there will be a demand for hotel accommodation. The main facilities for welfare and social needs are as follows: one cafe and one public house per Catchment Unit; one branch library, a community centre (incorporating various sized halls, theatre, meeting rooms and gymnasium), an hotel, a health centre, one to two cafes/restaurants and several public houses per district centre.

The regional centre will contain most of the professional and entertainment services. The role of Falkirk will be dealt with in detail in the Chapter "Process of Application". Specific facilities for commercial entertainment other than that accommodated in the community centres will need to be provided as the demand arises.

Good access by car and public transport will be needed for facilities in both district and regional centres, and double use of the parking space provided for shoppers will be possible where community facilities are open in the evening. The provisions for recreational facilities, recreational open space and pedestrian greensways are elaborated in the section "Towards a Feasible Recreational System".

## Environmental Areas

In 1963 Professor Buchanan, in his Report "Traffic in Towns", introduced the idea of "Environmental Areas" into the techniques for planning urban areas. The term "environment" can be said to cover broadly "the general comfort, convenience and aesthetic quality of the physical surroundings for living". But in a more specialised sense it can refer to "those aspects of the environment . . . directly or indirectly affected by the presence of vehicles". Derived from this is the Environmental Area "having no extraneous traffic or within which considerations of environment will predominate over the use of vehicles". Thus, closely associated with freedom of pedestrian movement is the notion of surroundings which are convenient and aesthetically stimulating. The concept of an Environmental Area can be used in controlling harmful intrusions into the residential environment, presenting an acceptable framework for new or existing development in the settlement. Subsequent studies have led to a method of determining the optimum size and structure of an Environmental Area.

Environmental Areas will consist of groups of people whose living conditions will be preserved against extraneous traffic and other harmful influences. Structure and size will be conditioned by four factors: a satisfactory micro-environment; a special or cohesive character; adequate distribution of community facilities; physical limitations by roads of distributary function.

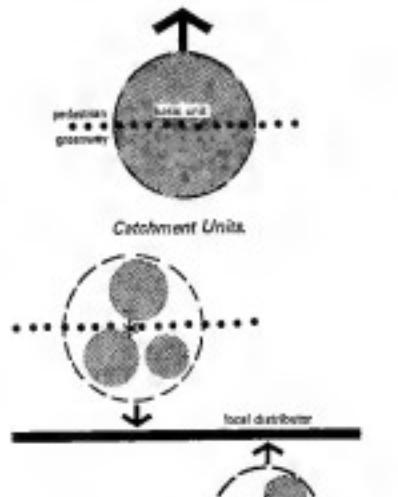
The idea of Environmental Areas could be applied to all of the main urban functions, and standards would vary accordingly. Residential development, which has the most varied and stringent requirements, is considered here. New development should create the best kind of living conditions and offer

adequate services for the efficient functioning of family and community life. The four factors above can then be translated in more detail into design principles for residential areas to avoid the repetition of social deficiencies and extreme nuisance found in existing urban areas.

A satisfactory micro-environment must relate to safe circulation for pedestrians and vehicles, protection from adverse effects or shortcomings of the climate, reasonable privacy and outlook, easy access to public or private open space, and integrated landscaping. A special or cohesive character must influence the range of density and dwelling types, the type of development (physical and social), the standards of layout, design and materials, and the relation of development to its site. The adequate distribution of community facilities will depend on their convenient location from the viewpoints of distance, pedestrian and vehicular access and on their having satisfactory sites free from all kinds of nuisances. The physical limitations of the Environmental Area will be formed by encircling roads whose distributary function will safeguard residential areas from extraneous traffic, reducing flows to a level which allows safe internal pedestrian circulation, and functioning as one of the components in the road hierarchy canalising traffic movements by varying standards of capacity, junctions and speed (see "Towards an Acceptable Communications Network").

Residential areas in settlements ideally should comprise a cellular system of related and compatible functions, set within an interlacing network of distributary highways. The Basic Unit should be

Basic Residential Unit.



Environmental Areas.

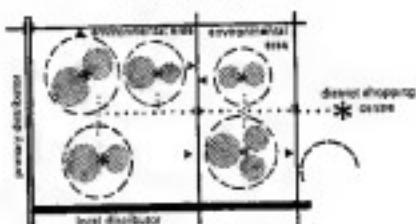


Diagram VII: Residential Structure

one elementary component in this system, since it generates an acceptable volume of traffic with regard to pedestrian safety; can support the simplest scale of shopping facilities (e.g., "corner" shop); supplies the number of children needed for one stream of a primary school; and requires only the simplest scale of recreational and open space facilities (e.g., greenways, playspaces).

However, with this size of population the community facilities which can be provided are limited in range. Trends are towards a local shopping group, which can offer a better range of goods and foster competition, and towards more economically sized primary schools of two streams or larger. The Basic Unit is a useful size with regard to internal pedestrian and traffic circulation, but cannot be said to fulfil completely the definition of traffic requirements for an Environmental Area, since this definition refers to roads of distributor function. Therefore, the Environmental Area must be a major component of the system and comprise several Basic Units. It is now possible to define the size of Environmental Areas (see Diagram No. VI).

The minimum size of an Environmental Area must satisfy the four requirements. A satisfactory micro-climate and cohesive character can be assured by detailed design and the exclusion of "non-conforming" land uses. Traffic generated by several Basic Units will require roads of a distributor function. The most important factor determining the minimum size, however, will be the provision of adequate community facilities and, in particular, shops and schools. A group of local shops

can be supported by a catchment of two to three Basic Units within a maximum walking distance of a quarter of a mile. A primary school for two streams of children can be supported by two Basic Units. The minimum size Environmental Area would therefore be two to three Basic Units (3,500-5,250 pop.).

Since larger populations can support more sophisticated community facilities and micro-climate and character can still be safeguarded by careful design, then the maximum size of the Environmental Area will be determined by the capacity of the local distributor roads. The character of the local distributor road has been determined by the requirements of the road network hierarchy and would also accommodate buses. Noise levels could be absorbed by tree planting or reduced by specially designed layouts. No frontage development would be allowed on this road, but access would be possible to community facilities served by the bus network. Pedestrian crossings would have to be strictly controlled or separated where pedestrian volumes are high. The maximum size Environmental Area can be deduced thus:

$$\text{Capacity of residential road serving Basic Units} = \\ 300 \text{ v.p.h. (18 ft.)}$$

$$\begin{aligned} \text{Capacity of local distributor road serving several} \\ \text{Basic Units (3-lane all purpose; high capacity} \\ \text{junctions)} &= 1,800 \text{ v.p.h. (33 ft.)} \\ 1,800 \\ \hline \end{aligned}$$

$$----- \text{ v.p.h.} = 6 \text{ Basic Units (10,500 pop.)} \\ 300$$

TABLE 2: Model Community Structure

Population (thousands)	Residential	Recreation	Education and Health	Shopping	Other Community Facilities
1		CHILDREN'S PARK	(Nursery School)		
2	Basic Unit	LOCAL PARK	PRIMARY SCHOOL	LOCAL CENTRE	PUBLIC HOUSE CAFE
3	B.U. Catchment Unit min.				
4	Environmental Area min.		NURSERY SCHOOL		
5	B.U. Catchment Unit max.				
6					
7	B.U.				
8					
9	B.U.				
10	B.U. Environmental Area max.				
11					
12	B.U.				
13			SECONDARY SCHOOL		
14	B.U.	DISTRICT PARK	HEALTH CENTRE	DISTRICT CENTRE	COMMUNITY CENTRE Branch Library Hall/Theatre Hotel
15					
16	B.U.				
17	B.U.				
18					
19	B.U.				
20					

The maximum size Environmental Area therefore would be six Basic Units (10,300 pop.).

Thus, the definition of Environmental Areas allows a measure of flexibility. It comprises two to six Basic Units (which may be grouped into one to three Catchment Units) and could be most accurately applied in new residential development. Environmental Areas could also be defined in existing urban areas, but difficulties arise where the road provision is generous and community facilities are under-provided. However, this is a situation which it is possible to improve with modest expenditure through revitalisation techniques. A "Model" community structure has now been built up related to the different scales of catchment populations and is shown in Table No. 2.

### Revitalisation of Existing Residential Environment

The Environmental Assessment study of residential areas showed that few areas would still have satisfactory environments by 1986, judged by increasing standards of affluence. Recurring characteristics indicated that those areas given the lower ratings could be improved. Therefore, areas suitable for environmental revitalisation could be defined in order to achieve a satisfactory or good environment for the maximum number of residential areas. For revitalisation to be viable, expenditure should be minimal and directly related to the life of the dwellings. Revitalisation could be tackled as a step towards implementing the new urban structure for existing areas.

The results of the Environmental Assessment showed which areas failed to meet the optimum environmental standards and, together with information from the Housing Survey, these areas can be graded into suitability for revitalisation. Action or improvement can range from redevelopment to simple painting, resulting in varying degrees of expenditure. Solutions for areas having deficiencies may be: provision of off-street parking spaces or garages; provision of children's play spaces and adults' sitting areas; tree planting and landscaping; closure of roads to make cul-de-sac layouts and keep traffic volumes to tolerable limits; creation of pedestrian routes; reduction in garden lengths in certain types of layout to obtain partial pedestrian/vehicular separation; rationalisation of traffic circulation to limit access to and from main traffic networks; improvement of shopping and social facilities; removal of non-conforming land uses; utilisation of derelict sites as a priority in develop-

ment; encouragement to remove or rebuild unsightly garden sheds or outbuildings; progressive face-lifting such as controlled repainting and repairs to fencing, etc. Opportunities should be taken to introduce the proposed urban structure wherever redevelopment is necessary.

Using information from the Housing Survey on age, condition and expected life-span the residential areas within the 'B' (Fair) class of the Environmental Assessment could be divided into two further sub-ratings: (1) Suitable for long term improvement (15+ years' life); or short term improvement (5-15 years' life). (2) Not suitable for improvement (0-5 years' life).

Some areas which have been included in the 'Fair' category solely because of traffic nuisance would otherwise have a higher rating similar to other dwellings adjacent. Where restricted space between buildings and lack of alternative access prevents any immediate solution, upgrading may be possible later when extraneous traffic is redirected on to the new road network. It is to be expected, however, that through the life-spans of many existing residential layouts far from ideal conditions of traffic circulation may have to be accepted for some time. The revitalisation possibilities within the lower ratings of the Environmental Assessment can be defined as follows:

Areas rated 'A' are suggested for redevelopment only.

Areas rated 'B' may be further subdivided as above. Where the sub-rating indicates unsuitability for improvement, redevelopment is desirable and would create opportunities to plan more comprehensively where these areas occur close to 'A' ratings. Where the sub-rating indicates suitability for improvement, this may be either long or short term but, if adjacent to main traffic routes and otherwise satisfactory, improvement may depend on the phasing of the Plan.

Within areas rated 'C' some improvement is usually desirable, such as rationalising a generous road pattern, increasing parking and garaging facilities and providing adequate play spaces and pedestrian routes.

Areas suitable for revitalisation can therefore be classified as follows and proposals made:

1. Areas of poor environment and/or imminent obsolescence and suitable for redevelopment.
2. Areas suitable for improvement (long or short term).
3. Areas along an existing main traffic route possibly suitable for improvement later.

## 2. Towards an Acceptable Communications Network

The main implications emerging from the study of traffic within the Area have shown the vital need for developing a comprehensive approach to the many problems involved, and that a judicious balance must be achieved between the often conflicting requirements of mobility, accessibility and environmental quality. Such an approach has become all the more necessary since the normal increase of car ownership will be associated with a major increase of planned population and industrial growth. This study has therefore considered not only the existing and future traffic and environmental needs, but also the potential role of an improved public transport system, linked with appropriately located and controlled car parking facilities, which should make possible the achievement of a satisfactory communication network which is also economically acceptable.

The solutions adopted adhere to "Bochum" principles outlined in "Traffic in Towns", meeting future traffic requirements and at the same time safeguarding environmental areas.

### The Transportation Advisory Group<sup>(1)</sup>

In carrying out this study the Regional Consultants have had invaluable assistance from a Roads Technical Committee consisting of technical

<sup>(1)</sup> The Transportation Advisory Group, under the chairmanship of Mr. R. T. Bigwood, was composed of the following members: F. Humphreys-Liddow, R. G. H. Turnbull, K. C. Westrop, S. W. Wood (Scottish Development Department), W. P. Frame, W. B. Jarvis (Stirling County Council), P. R. B. Brown, J. Buchan (Paisley Burgh), S. Domicell, J. Koslowski, Miss A. McIntyre (Regional Consultants).

representatives of the Scottish Office and of all the local authorities involved; and to process and translate into recommendations the formidable volume of traffic data that had been assembled this Committee set up a Transportation Advisory Group at its Fifth Meeting on 15th November, 1965, with the following terms of reference:

To assist the Regional Consultants with their task of preparing an Advisory Master Plan for the Grangemouth/Falkirk Growth Area by preparing a transportation plan with particular reference to the road networks required to serve the urban areas, to ensure the satisfactory provision of roads for "through" traffic and for the requirements of the tourist industry;

that taking a realistic view of the limited resources available for undertaking this urgent task, a detailed traffic study is not possible and that appropriate estimates and assumptions will therefore require to be made;

that since the Regional Consultants in their Final Report will recommend that a comprehensive transportation study be carried out for the Greater Edinburgh and East Central Scotland area (similar to the Greater Glasgow Study) as soon as possible, it would follow that the task now being undertaken by the Transportation Advisory Group would be affected and its conclusions modified by the results and recommendations of the subsequent Transportation Study.

The Transportation Advisory Group subsequently carried out its traffic analyses on the basis of comprehensive surveys and tentative development proposals for the Area, which had culminated in Regional Model 7 (see Phase One, First Synthesis).

#### Traffic Principles and Roads Hierarchy

Hierarchical road networks were evolved for Model 7 to serve the various traffic functions in accordance with the agreed principles. The terminology adopted for these road networks was based upon "Buchanan" principles, since these were found to be applicable to the existing recognised hierarchical systems: national, regional and Growth Area. Each system was conceived as being complete in itself, connecting with other immediately related systems at selected frequencies. Four such theoretically independent systems were postulated within the context of the Growth Area:

- National and Regional Connectors
- Growth Area Primary Distributors
- Growth Area District Distributors
- Growth Area Local Distributors

#### National Regional Road System (Red Road System)

**FUNCTION:** This system links cities and growth areas within the Region of Central Scotland. Those roads forming this system, which traverse the Growth Area, will serve "through" and Growth Area bound traffic, originating outside the Area, and traffic originating in the Growth Area but journeying beyond its boundaries. This traffic will be very mixed: heavy goods vehicles, commuter and recreational traffic.

**COMPONENTS:** This system should consist of high-capacity National and Regional Roads, of motorway and dual carriageway standard with limited access.

**PRINCIPLES:** This system would carry long-distance traffic only and would bypass all settlements within the Growth Area. Intersections at suitably spaced intervals would allow traffic to flow freely and provide good accessibility to and from the Growth Area's distributor systems. A design speed of seventy miles per hour was used for this system.

#### Growth Area Primary Distributor System (Black Road System)

**FUNCTION:** This system, fully developed within the boundaries of the Growth Area, would provide convenient linkages between major industrial areas and the docks and between major urban areas and employment concentrations. Traffic would consist of heavy goods and commuters both by car and public transport. These would have an origin and destination within the Growth Area, or be travelling to or from nearby centres of population or employment.

**COMPONENTS:** This system would be generally of dual carriageway standard with limited access, mainly new routes.

**PRINCIPLES:** This system would carry high long- and short-distance traffic, bypassing all urban areas. Optimum accessibility would be encouraged between residential areas and the major industrial zones by canalisation where necessary. Commuter journeys within the Growth Area would be minimised by high-standard road design to a period not expected to exceed a total of thirty minutes. Intersections would provide for free flow and restricted traffic movements according to development needs. A design speed of fifty miles per hour was used for this system.

#### Growth Area District Distributor System (Blue Road System)

**FUNCTION:** This system would connect existing and proposed developments and provide good access to the Growth Area's main commercial centre and its various district centres. It would serve commuters generated by office and service employment, shoppers and others making trips between settlements.

**COMPONENTS:** This system would comply with District Distributor standards, with some sections having dual carriageways but having restrictions on access, and using existing roads wherever possible.

**PRINCIPLES:** This system would be complementary to the primary distributor system and would provide for all major internal movements, bypassing some, and giving access to other new and redeveloped urban areas. Some free-flow intersections would provide adequate access onto the primary distributor system, so as to divert excessive traffic from urban areas. A design speed of forty miles per hour was used for this system.

#### Growth Area Local Distributor System (Yellow Road System)

**FUNCTION:** This system would serve all settlements, connecting existing and new residential areas with local industrial sites and centres. It would cater for "all-purpose" town trips, especially local traffic originating in residential areas, short distance commercial traffic and public service vehicles.

**COMPONENTS:** This system would be of single carriageway standard with few road access limitations, mainly using existing roads except in new development.

**PRINCIPLES:** This system consists of classified town roads, generally linking and serving environmental areas and their community facilities. Main local traffic flows would be canalised and vehicular-pedestrian segregation should be provided where appropriate. Intersections with district distributors should be carefully designed and controlled as components of the urban environment. A design speed of thirty miles per hour was used for this system.



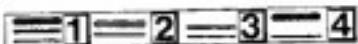
1. Theoretical Concept



2. Application to the Area



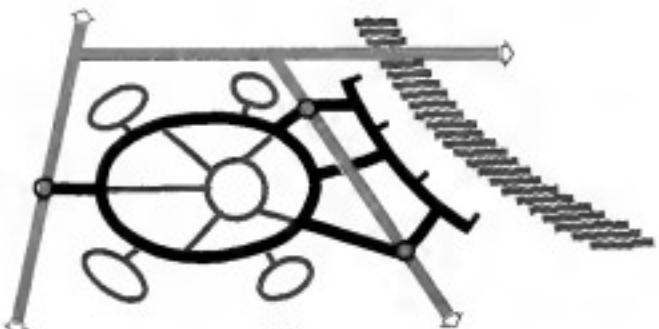
3. Examination



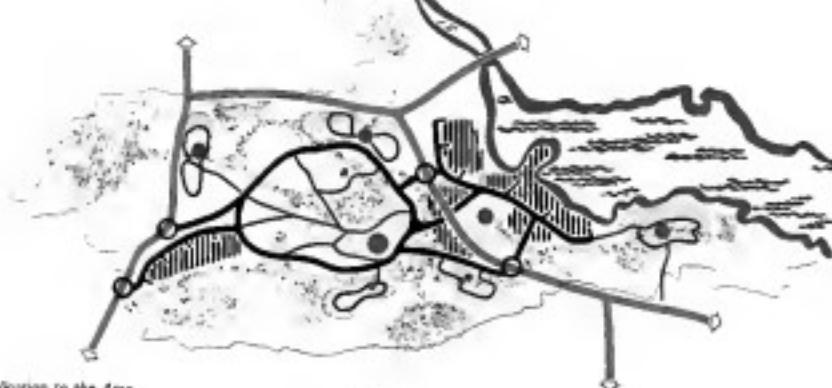
*Map No. 58: Spine and Rib Road System*

*Key to fig. 3:*

1. New roads to be built (motorways or dual carriageways, primary or district distributors and local roads).
2. Major improvements needed (existing "A" roads to be adapted as motorways or dual carriageways and existing "B" roads to be adapted as primary or district distributors).
3. Minor improvements needed (existing "A" roads to be adapted as primary or district distributors and existing "B" roads to be adapted as local distributors).
4. No improvements needed (existing motorways and dual carriageways to be kept at the same level and existing "A" roads to be used as local distributor).



1. Theoretical Concept



2. Application to the Area



3. Examination

**1 2 3 4**

*Map No. 69: Radial Road System*

Key to fig 3:

1. New roads to be built (motorways or dual carriageways; primary or district and local roads).
2. Major improvements needed (existing "A" roads to be adapted as motorways or dual carriageways and existing "B" roads to be adapted as primary or district distributors).
3. Minor improvements needed (existing "A" roads to be adapted as primary or district distributors and existing "B" roads to be adapted as local distributors).
4. No improvements needed (existing motorways and dual carriageways to be kept at the same level or to be used as primary distributors and existing "A" roads to be used as local distributors).

The hierarchical classification of roads for the Growth Area was completed with the study of local residential roads serving the various residential units within environmental areas (see Research Studies: towards an Ideal Urban Environment).

### Hypothetical Road Systems in the Growth Area

Several hypothetical road systems have been evolved for the Area, generally in relation to Model 7 (see Phase One, First Synthesis). All these systems have been developed in accordance with the principles outlined in the previous section of this Report, but some have been found to be more effective than others in achieving satisfactory standards. They have all been critically examined for advantages and shortcomings; for ease and suitability of programming and implementation; for engineering difficulties and cost. Three hypothetical systems, most likely to offer the most acceptable solutions, have been used for testing various possibilities which would lead to an ultimate road system for the Area, and these are briefly outlined below: Spine and Rib Road System; Radial Road System; Hexagonal Road System.

#### Spine and Rib System (See Map No. 59)

This system provides a primary distributor and two district distributor "ring roads". It provides direct links (at the upper level of the road hierarchy) between the east and west of the Area, and offers good possibilities for a relatively economical solution to the problems of vehicular/pedestrian separation. At the lower end of the road hierarchy, the system gives rise to considerably longer vehicular journeys; offers only a restricted choice of alternative routes; and provides few opportunities for segregating the various types of traffic.

When this system is related to the various physical characteristics of the Area, the land adjoining the Forth and Clyde Canal offers a convenient route for the spine roads. The ring roads however suffer irregularities in their alignments when adapted to serve the urban areas. The spine divides the Area into two parts, separating the main centre at Falkirk to the south, from development to the north; but it gives very good linkage between the two major industrial zones. When applied to the Area, the spine and rib system requires the following scale of development:

- A. Total length of new and improved roads ... ... ... ... 75 miles
  - B. Total length of new roads only ... ... 28 miles
- Cost index for the spine and rib system
- |   |             |
|---|-------------|
| A | 75          |
| I | — — — = 2.6 |
| B | 28          |
- (for details see Table 2)

#### Radial Road System (See Map No. 60)

This system provides the most satisfactory accessibility between the various urban areas, and allows alternative choices for traffic wishing to bypass to Falkirk's Central Area, but it does not allow sufficient flexibility, and is not satisfactory when a number of district centres co-exist within the urban areas. This system would however be satisfactory if the existing proposal for M9 (north of Longdyke) was realigned in a westerly direction; with the future A876 diverted from Kincardine Bridge and redesigned to take internal traffic generated by the Area. "Through" traffic flows would then be diverted around the Area, and development could proceed without the difficulties of coping with heavy "by-passable" traffic traversing potential urban areas. This system allows for the separation of

various types of traffic from each other and would encourage the growth of Falkirk as the regional centre.

Taking into account the existing road network with its potential for improvement and committed road construction programmes, the system requires the following scale of development:

- A. Total length of new and improved roads: (i.e. new roads required plus all road improvements): Primary and district distributors ... ... ... ... 59 miles
  - B. Total length of new roads only ... ... 19 miles
- Cost index for the Radial Road System
- |   |             |
|---|-------------|
| A | 59          |
| I | — — — = 3.1 |
| B | 19          |
- (for details see Table 2)

#### Hexagonal Road System (See Map No. 61)

This system is most efficient in linking various centres of similar size and character within a sub-region containing numerous small settlements: it also has many advantages in affording routes for "by-passable" traffic. It offers flexibility; is convenient for future road extensions, and requires only simple inter-sections. Its shortcomings are that it is less direct than conventional systems, and this creates longer journeys.

In relating this system to the Area, the one-mile module that is used obviously must be adjusted to provide conveniently located intersections to serve the various urban areas. It provides several alternative routes for all the urban areas which facilitate a greater degree of segregation of traffic. This system also overcomes many of the problems of access to environmental areas.

When applied to the Area, the hexagonal grid system requires the following scale of development:

- A. Total length of new and improved roads ... ... ... ... 82 miles
  - B. Total length of new roads only ... ... 36 miles
- Cost index for the hexagonal grid system
- |   |             |
|---|-------------|
| A | 82          |
| I | — — — = 2.2 |
| B | 36          |
- (for details see Table 2)

#### Conclusions

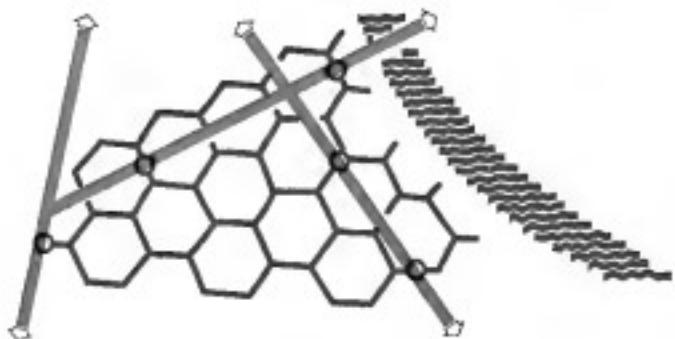
From this analysis, the radial road system appeared to provide the most acceptable road network for the Area: it makes good use of existing roads; has the best Cost Index rating; and allows the greatest flexibility for urban growth.

The analytical studies on traffic principles and road functions and this study of hypothetical road systems have defined some of the general traffic problems. They have also revealed an acceptable hypothetical road system which appears to meet the need of existing and proposed development shown in principle in Regional Model 7 (see Phase One, First Synthesis). Detailed traffic studies will not now be necessary to test the hypothesis before finally formulating a road network for the Area.

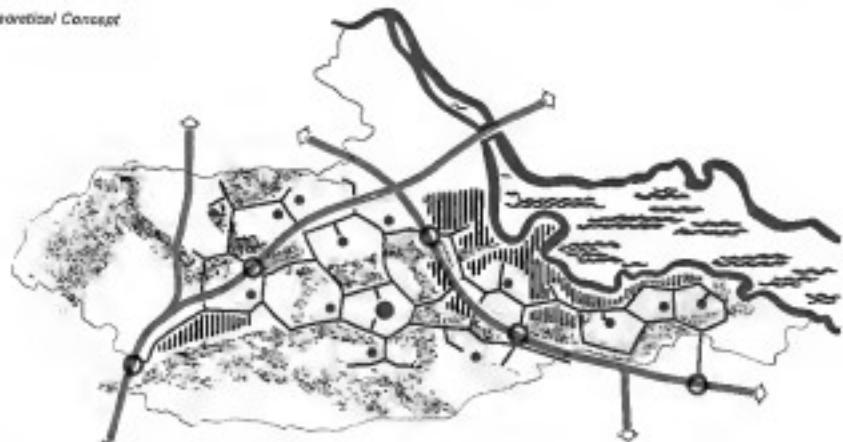
#### Policy Assumptions for calculating the Growth Area's Traffic

##### Car Ownership

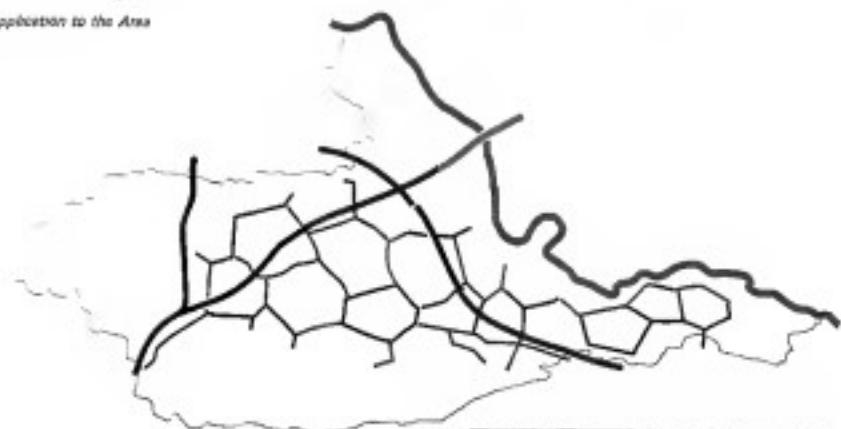
The Road Research Laboratory of the Ministry of Transport forecasts for the U.K. a doubling of both vehicle ownership and vehicle miles travelled between now and 1980, reaching an approximate ratio of one vehicle (all types) per two people by 1985. In Stirling County Council, between 1955 and 1964, the growth in cars licensed averaged 10% compounded per annum, bringing the total to approximately one car per eight persons by 1964.



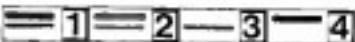
1. Theoretical Concept



2. Application to the Area



3. Execution



Map No. 61: Hexagonal Road System

Key to fig 3:

1. New roads to be built (motorways or dual carriageways and primary or district distributors).
2. Major improvements needed (existing "A" roads to be adapted as motorways or dual carriageways and existing "B" roads to be adapted as primary or district distributors).
3. Minor improvements needed (existing "A" roads to be adapted as primary or district distributors).
4. No improvements needed (existing motorways and dual carriageways to be kept at the same level).

TABLE 1

*Spine and Rib Road System*

	New Roads to be Built (in miles)	Major Improvements Needed (in miles)	Minor Improvements Needed (in miles)	No Improvements Needed (in miles)	TOTAL (in miles)
Motorways & Dual Carriageways ...	8.0	3.0	—	11.5	22.5
Primary & District Distributor Roads ...	20.5	7.5	24.5	—	52.5
<b>TOTAL ...</b>	<b>28.5</b>	<b>10.5</b>	<b>24.5</b>	<b>11.5</b>	<b>75.0</b>
Local Distributor Roads ...	9.0	—	3.0	7.0	19.0
<b>TOTAL ...</b>	<b>37.5</b>	<b>10.5</b>	<b>27.5</b>	<b>18.5</b>	<b>94.0</b>

$$75.0 \div 28.5 = 2.6$$

TABLE 2

*Radial Road System*

	New Roads to be Built (in miles)	Major Improvements Needed (in miles)	Minor Improvements Needed (in miles)	No Improvements Needed (in miles)	TOTAL (in miles)
Motorways & Dual Carriageways ...	7.0	1.5	—	7.5	16.0
Primary & District Distributor Roads ...	12.0	4.5	22.5	4.0	43.0
<b>TOTAL ...</b>	<b>19.0</b>	<b>6.0</b>	<b>22.5</b>	<b>11.5</b>	<b>59.0</b>
Local Distributor Roads ...	12.0	—	11.0	6.0	29.0
<b>TOTAL ...</b>	<b>31.0</b>	<b>6.0</b>	<b>33.5</b>	<b>17.5</b>	<b>88.0</b>

$$88.0 \div 19.0 = 3.1$$

TABLE 3

*Hexagonal Road System*

	New Roads to be Built (in miles)	Major Improvements Needed (in miles)	Minor Improvements Needed (in miles)	No Improvements Needed (in miles)	TOTAL (in miles)
Motorways & Dual Carriageways ...	9.5	1.5	—	11.5	22.5
Primary & District Distributor Roads ...	26.5	9.0	24.5	—	60.0
<b>TOTAL ...</b>	<b>36.0</b>	<b>10.5</b>	<b>24.5</b>	<b>11.5</b>	<b>82.5</b>
Local Distributor Roads ...	—	—	—	—	—
<b>TOTAL ...</b>	<b>36.0</b>	<b>10.5</b>	<b>24.5</b>	<b>11.5</b>	<b>82.5</b>

$$82.5 \div 36.0 = 2.3$$

Recent traffic studies carried out at Falkirk established that, owing to the present trends in car ownership and traffic growth, the number of cars in Falkirk will rise to a ratio of one car per 2·7 persons by 1983, which is slightly higher than the equivalent for the U.K. as a whole (2·9 persons).

After considering local and national car ownership rates and future projections made by Mr. J. C. Tanner of the Ministry of Transport, it was decided that an overall car ownership of 0·33 cars per head in 1986 should be assumed for the Growth Area as a whole. After 1986, further increases in population and in the rate of vehicle ownership should result in an ultimate ownership rate of 0·4 cars per head about the turn of the century, assuming a moderately restrictive attitude towards motoring.

#### **Public Transport**

The modal split adopted for the Area assumes a high standard of public transport, based on a re-nationalisation of rail and bus services. Flexible bus services, used as "feeders" on circular routes, have therefore to be provided with convenient access to the Area's railway stations. On this basis, and in line with previous experience, an average number of forty passengers per bus was considered a reasonable design factor for peak hours. It was also envisaged that the existing rail system in due course might be adapted for other forms of public transport.

It is anticipated that the continual growth of traffic will require some restriction upon the free use of the private motor vehicle within areas of concentrated land use within the Area, but these will need to be co-ordinated with corresponding improvements in public transport services and the provision of car parking, preferably under the control of co-ordinating authority.

#### **Traffic Assumptions**

The conversion from "person trips" to "passenger car units" was made on the basis of the following traffic assumptions:

#### **Car Ownership**

Agreement on the above mentioned local and national rates and future projections gave a ratio of 0·61 cars per worker.

#### **Off-Peak Travel**

To allow for workers who will not travel during the peak hour, the work journeys were reduced by fifteen per cent.

#### **Car Usage**

It was assumed that fifty per cent of the workers with cars would use them on the journey to work and that there would be 1·2 persons per car (this implies the existence of very good public transport services).

#### **Bus Capacity**

It was assumed that the average number of workers carried in a bus would be forty persons.

#### **Modal Split**

The following is the assumed modal split of every hundred person journeys at inter-area movements (cyclists' and pedestrians' movements have been ignored since these are likely to be small and in all probability intra-area).

Off Peak—15; Car Driver—34; Passenger—7; Bus Passenger—44.

#### **Passenger Car Units (Urban) Per 100-Person Journeys**

The assumed modal split gives a p.c.u. (urban) factor of 45 per hundred person journeys. An allowance has been made in this of approximately twenty per cent additional p.c.u.s to cover commercial vehicles travelling in the peak hour and for shopping traffic and other private journeys.

#### **Peak Hour**

For the purposes of the calculations, the journey home from work has been used, since this is normally the more intense of the two peak periods.

#### **Scope of the Transportation Study**

##### **Traffic Generation: Regional Model 7**

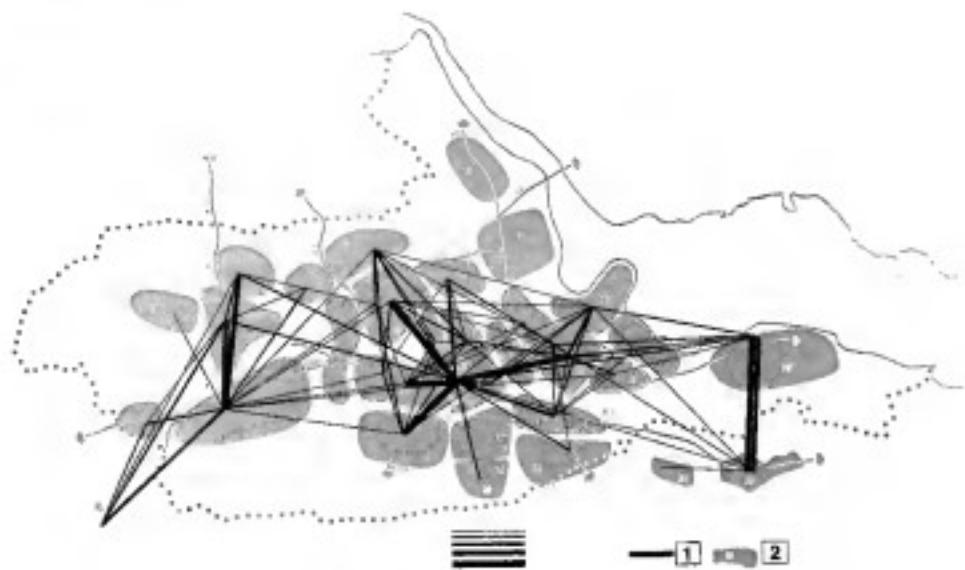
Regional Model 7 (231,000 population by 1986, distributed over some eighty square miles) established a wide distribution of urban areas with populations ranging from 12,000 to 65,000. The total number of future job opportunities within the Area amounted to some 92,000 (without considering industrial developments at Skirland). Concentrations of activity were located in Falkirk's central districts and around Grangemouth and Bonnybridge. Within the latter two areas the expected ratio of jobs to population in 1986 is exceptionally high (one to one). Grangemouth and Bonnybridge, some eight miles apart, were shown on Model 7 to be developed for "low-density" manufacturing industry; while Falkirk, lying at the heart of the Area, was shown as the main centre with high-density tertiary employment. Peripheral urban areas have widely varying ratios: Denny with one job for six inhabitants, and Boness with nearly one job for every three inhabitants.

Dispensing employment and residential areas was expected to create a balance of commuter traffic flows throughout the Area, to which would be added the flows attracted to Falkirk's central districts. The national road network was already agreed before this study began, and a considerable amount of traffic information was available from recent studies carried out by the local authorities. With the available information, it was possible to consider the distribution of worker to job opportunities (or vice versa) and thereby obtain an estimate of the 1986 peak hour flows in person trips. These were readily converted to vehicle trips or passenger car units (p.c.u.s) for any assumed modal split. Ideally, this distribution should have taken into account differing car ownership rates and car usage characteristics for the various residential areas, the types of employment and volumes of shopping trips; but this was not possible within the limited scope of the study.

#### **Trip Distribution**

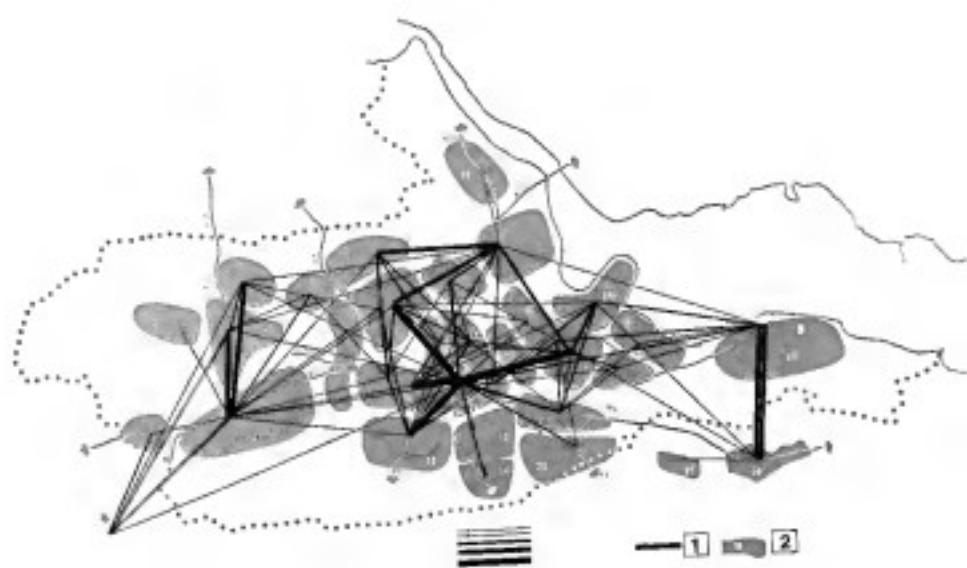
Two assumptions were necessary before calculations could be started: that the number of workers in the Area equalled the number of job opportunities (for calculation purposes, commuters into and out of the Area could therefore be ignored); that an average journey-to-work distance should be agreed.

The effect of ignoring "long-range" commuters was minimised in the final calculations by including nearby towns as zones in the distribution. An average journey to work of two and a half miles was finally adopted after considering the existing journey characteristics in Falkirk, Grangemouth and elsewhere. The Area was initially divided into nineteen zones, and bands (three miles wide) were then constructed circumferentially around each zone. The workers from each zone were distributed by means of an "Electrostatic Analogy Model" to the zone itself and to each of the bands surrounding it.



**Diagram VIII: Traffic Desire Line 1 — Evening Peak Flows**  
Key: 1. Desire Line. 2. Traffic zone

Note: The width of lines indicates the following number of work-trips:  
250-500; 500-1,000; 1,000-1,500; 1,500-2,000; over 2,000.



**Diagram IX: Traffic Desire Line 2 — Evening Peak Flows**  
Key: 1. Desire Line. 2. Traffic zone

Note: The width of lines indicates the following number of work-trips:  
250-500; 500-1,000; 1,000-1,500; 1,500-2,000; over 2,000.

Workers allocated a given band were then divided between the zones lying within that band in proportion to the job opportunities available. The repetition of these calculations for each of the zones gave a complex pattern of inter-zonal movements of varying size; the calculated and expected inter-zonal trips being balanced to within five per cent by an iterative process carried out by computer.

When this exercise had been completed, the average work journey was calculated by using an Index of two and found to be between 2·4 and 2·5 miles. Had the journey distance been very different from the 2·5 miles previously agreed, it would have been necessary to adjust the Index and recalculate until the desired average journey was obtained.

### Traffic Synthesis

On the basis of the calculated inter-zonal movements, desire and trend line diagrams were prepared and ultimately a preliminary road network was evolved for the Area. A manual assignment of traffic was made to this network and some very high traffic flows resulted: Bo'ness—Grangemouth—Falkirk; into Falkirk from proposed development in the south at Glen Village; and heavy traffic flows in the Denny-Bonnybridge area. In order to reduce these excessive traffic flows, as well as to obtain a further refinement in the study, adjustments were made in the allocation of industry and residential land uses, and a further recalculations of traffic flows was then undertaken by computer.

This final series of calculations took also into account the effects of traffic generators located outside the Growth Area: Linlithgow, Whitcross

and Cumbernauld. Alternative possibilities for industrial development in the Skinflats area was also considered and two sets of new calculations were made: (i) with 10,000 jobs at Skinflats and (ii) with no industrial development in that area. In both cases the total number of jobs was kept constant at 92,000, but the number of traffic zones was increased to thirty-two, to give greater accuracy. Desire-line Diagrams were prepared for both cases. The heaviest inter-zonal flows would be those into Falkirk, Bonnybridge and Grangemouth and those between Linlithgow and Bo'ness. With 10,000 jobs allocated to Skinflats, there would be heavy flows into this zone but no significant reduction in the major traffic flows elsewhere. In view of the importance of industrial development at Skinflats, a Trend-line Diagram was prepared for this case. This Diagram was prepared from the "desire-lines" data using the major movements of more than a hundred person trips in the peak hour, and is therefore based upon eighty-four per cent of all person trips (see Diagram Nos. VIII and IX).

A plan was prepared showing a road network which provided for these movements and for links to the National Road System. It was considered undesirable to use the National Road System for short journeys and the road system was therefore designed to discourage this type of journey by providing alternative routes to which interural traffic was assigned on the basis of shortest time/shortest distance. For the purpose of this computer programme speed values were allocated to each highway link, and delay times to each intersection, speeds being dependent upon the position of the roads in the hierarchy and the design standard.

## 3. Towards a Feasible Recreational System

More people, more leisure, greater affluence and mobility are a few of the often quoted factors which account for the rising demand for recreational facilities. Others, less obvious, include a greater selection of activities from which to choose; the influence of the mass media; work often uninspiring and lacking in achievement reward; and the spread of urbanisation, or the "synthetic environment", with its many accompanying stresses and strains.

### Principles

Too often, precedent is the accepted principle determining the pattern of places and events. This has tended to perpetuate recreation systems which are no longer compatible with modern society. The proposals for recreation were based on the following principles:

### Responsibility

Recreational facilities should be rather like icebergs, one-tenth expressed by open space, parks, etc., nine-tenths by the invisible infrastructure of administration and social services, which initiates, directs, guides and maintains. Without this weighting, the system is more like a cork, drifting on the surface without aim or purpose.

### Suitability

The success of any recreation scheme begins and depends on an understanding of the needs of the groups for which it provides. Criteria are based on psychological and physiological data, which vary with age, sex, occupation, etc.

The psychological, for example, include the enquiring attitudes of young children, often satisfied by exploring the possibilities of varied materials; and the enjoyment of discovering new sensations (tactile, visual, etc.). The physiological depend partly on the relationships between types of activity, and types of local climate. The so-called "Radiation Balance" predicts that heat-producing games like football may be played in comfort by energetic people in relatively low temperatures; and that older and young people, who need to conserve heat, should have sheltered, sunny and dry positions. "Satisfiability" will thus include the size and overall design of areas, depending on user density, primary functions, etc.

### Accessibility

This is a relative term, and depends on the age, physical ability, financial standing, means of transport, etc., of population groups; and will also include factors which affect their convenience and safety.

Two distinct factors appear here: the provision of access to areas especially suited to recreation, e.g. areas of outstanding natural beauty; and the provision of recreation areas readily accessible to the population they serve.

### Attractability

Without appreciating the need to be competitive in any way, parks in general have been following the *dodo's trail to obsolescence*. Commercial enterprise has now persuaded people to pay for entertainment, while the rates often maintain empty green acres. Only in densely populated areas can a green space

sell itself; elsewhere it has to be promoted. This can be done only by providing counter attractions comparable to the cinema, coffee bar or dance hall; or of a nature that captures people's imagination; or that meet needs which are not being satisfied elsewhere. People are drawn towards certain combinations of physical factors, like waterfalls, rocks, heather, trees. They like an objective to aim for in an outing to give them a sense of achievement or arrival. Thus viewpoints, mountain top, historic sites, areas of romantic and sentimental attraction or curiosity are ideal for inclusion in recreation systems.

#### Flexibility

It is a characteristic, and in some ways a paradox of the age, that the rate of change in habits, fashion and behaviour is accelerating, although the basic human needs of today are much the same as they were twenty thousand years ago. Fear, excitement, competition, aggression, curiosity, assertion, submission, display and satisfaction still drive people to express and behave themselves in characteristic ways. But nowadays there appears to be a need for change for its own sake; or to identify changelessness with lack of success, or the antithesis of desirability. Only the young and the old seem immune from this predicament. Recreation facilities must not neglect this demand, and should present an image which the public can recognise and accept. This may be achieved either by inventing new uses for old places, e.g. water skiing or sand yachting; or by inventing new places for old uses, e.g. the adventure playground or the discotheque.

#### Exploitability

Compared with more favoured areas like the Troughs or the East Coast, the Area is not rich in natural features which could be utilised in a recreation system; this makes it all the more important to conserve, and to take advantage of those which are there.

The Firth estuary, rivers, woods, moorlands, and the agricultural countryside come into this category, and have been included in the proposals.

#### Capability

Every area has a capacity for use, beyond which it either disintegrates, or loses its original or essential character. The first situation, the measurement of wear, is purely a technical matter; and the assessment of character is perhaps a matter of opinion. However, both fall within the ambit of a recreation administrative body, who have a responsibility to uphold certain standards of amenity and maintenance.

#### Extendability and Expandability

While recognising "change" as an inevitable phenomenon, it is necessary to make plans which may not mature for decades. The value of a proposal such as a regional walkway system would be greatly enhanced if priority were given to establishing a main arterial system, which could be extended as circumstances allowed. From this primary and permanent network, collector and distributive pathways could be added or discarded as developments demanded.

Two further complementary principles are relevant: concentration, and dispersal. The first aims at providing areas which are suitable for large numbers of people at relatively high densities, and in which movement in all directions is unrestricted.

The second directs people along selected routes, through areas where access would be detrimental to adjacent property, for example, arable agricultural land; or to much larger areas of open space, like the open hills, where the low intensity of use does not destroy the essential characteristics, like silence or solitude, or the vegetation.

#### Recreational Components

At this point principles and potential converge; Map No. 62 "Recreation", based on the Growth Potential Studies, shows those elements of the Area which have considerable potential for recreation. When related to the general principles, and to the standards which were produced by the Lothians Regional Survey and Plan, the following more specific recreational components were evolved, including a park system, and a regional pedestrian network. The Lothians standards have been modified to meet the requirements of the Environmental Areas.

Four types of park have been suggested to meet the requirements of different age groups and activities: Children's, Local, District and Regional.

#### Children's Parks

There should be a Children's Park in each Basic Residential Unit, providing approximately 1.6 acres per estimated population. For the average unit of 1,250 people this park should be about 2.6 acres in extent. Children's parks see areas planned for imaginative, creative and sometimes vigorous outdoor play of school children. These parks supplement the home by providing experiences not possible at home, create a focus for the children, and help in their development as social beings. They should be integrated with the residential areas, free from traffic hazards, readily accessible to mothers and children and should be sited so as to afford casual visual supervision.

It may be considered desirable that different age groups of children should have separate playgrounds or separate enclosures in a playpark. It is undesirable to draw hard and fast divisions at various ages and rates categorically that a child's interest will change and develop from the nursery stage to the infant stage as soon as he has reached the age of five. In reality, children develop at different rates and older children may wish to accompany their younger brothers and sisters into playground assigned to the younger age group.

It is desirable that the playspaces and playparks should be designed to induce imaginative play and make-believe, and that mechanical equipment should be kept to the minimum. Children's areas may well be sited within local and district Parks, but accessibility and casual visual supervision are the main factors in their location. The small "incidental spaces" produced by areas unsuitable for houses because of physical characteristics, and retained or developed tree clumps provide the ideal setting for the younger (0-5) age group, who could be provided with climbing blocks, etc. The 5-10 age group requires swings, climbing frames, etc., and maybe paddling/bathing ponds. This age group generates more noise, a fact which should be considered when their facilities are to be sited in the local park.

The 10-15 age group facilities should be sited among such physical site irregularities as will provide opportunities for constructive play. There should be space for team play. Again, the local park may provide the setting for their facilities.

The so-called "junk" or adventure playgrounds seem more enjoyable to children than the standard "fitted" playgrounds. They are, by their nature,

inexpensive both to install and maintain although supervision costs are higher and would be a valuable addition to the children's park system. They may seem unsightly to the sensitive adult, however, and should be suitably screened and landscaped.

The following sum of 2·6 acres should be a guide to the "space standards" for the children's parks for a population of 1,750.

- 0-5 age group, about 0·6 acre
- 5-10 age group, about 1·6 acres
- 10-15 age group, about 0·4 acre

#### *Local Parks*

There should be a local park for each catchment area served by a local shopping centre, providing approximately 3·5 acres per thousand population. The average park should be about twelve acres, serving a population of about 3,500.

Local parks should be closely related to centres of activity, and complementary to them. This almost inevitably means the evolution of a shopping-school-park complex, within a maximum walking distance of half a mile from all homes, possibly incorporating the dual use of playing space for school and after-school use. Adequate and informed supervision of a non-disciplinary nature is essential. Depending on size and situation, each local park will include one of the children's parks previously described.

These parks must also cater for the "over 15's", an age by which the youth leader has emerged as an integral character and a potent force. An enclosed space and club hut, combined with a fair degree of autonomy, under the unobtrusive direction of a youth leader, give youth the sense of identity they need, and the freedom to express and satisfy their new-found independence.

The local park has an important part to play as a social and community centre, and instead of following the traditional pattern of insularity, should be a cohesive element providing the background to diverse social services. It should include amongst its facilities:

- 2 grass pitches 4·5 acres
- 1 all-weather pitch 2·25 acres
- or 1 all-weather junior pitch 1·75 acres
- 1 bowling green 0·75 acre
- 3 tennis courts 0·5 acre

The usefulness of the park will be greatly improved if provision is made for floodlighting.

#### *District Parks*

There should be at least one district park associated with each district shopping centre, with an optimum provision of one district park per 10,000 population. Their establishment would be phased, to give one initially to each of the nine districts; these could then be expanded at a later date, or a completely new park provided elsewhere. The approximate provision is two acres per thousand population, the parks being about twenty acres in extent.

District parks should be planned to cater for all age groups, providing outdoor and indoor facilities to meet a wide range of recreation and leisure interests.

Among the facilities at the park could be fields and courts for various sports, sports hall, community centre for arts, crafts, club and social facilities, children's play areas and a creche which would allow parents to participate in a leisure activity. Facilities could be used by schools, sporting clubs, amateur groups and individuals interested in some activity which the park provides.

The location of the park should be integrated with the pedestrian-way system of the community it serves, but the following should guide the choice of location:

- a. The further the park is removed from the centre of the community it serves, the less effective it will be.
- b. The sports hall, community centre and youth club could be considered as one complex in the area devoted to recreation. But if so place the indoor facilities near an outdoor playing field area would mean taking the building a considerable distance from the concentration of population, then the choice should be to locate the indoor facilities close to the urban centre.

The following should guide the facilities to be used in a district park, and indicate the space requirements:

- 4 senior all-weather pitches (9·00 acres) with floodlighting; 2 grass pitches (4·50 acres), cricket table (0·25 acre), athletics track (0·75 acre), and 3 tennis courts (0·50 acre) with floodlighting; sports community hall with car-parking (1·00 acre); i.e. basic space requirements of sixteen acres net, allowing for wastage.

The use of all-weather pitches in both district and local parks is recommended.

The main reason for recommending all-weather playing surfaces is to reduce maintenance; the area is characterised by clay sub-soil which floods easily, making existing pitches unusable for many days per year.

The two basic types of all-weather surfaces for games and sports are the cinder type and the rubber type.

The cinder type surface in use in Great Britain has proved quite successful as an all-weather surface since it will withstand hard and continuous use over a period of time; pitches are usable under most adverse weather conditions, and requires less maintenance than ordinary grass surfaces.

The rubber surface is, however, more efficient since it can withstand hard and continuous wear for very long periods more successfully than the cinder type; maintenance is virtually nil; line markings for play may be painted on as a permanent fixture if required; gravel rash from falls is avoided, and changes from one game to another, e.g. football and tennis, can be effected in a matter of minutes since no repair or maintenance is required before the change is made. Grangemouth already have a track of this type which will provide local opportunities for comparison.

All-weather surfaces are an advantage over grass because adverse weather conditions do not affect play (the rubber type surface, for example, will withstand thirty degrees of frost and since the surface is porous, will not lift with frost); the hazard of mud is obviously non-existent and heavy downpours of rain will not render the surface unusable (i.e. these surfaces can be used all the year round). They are more expensive to lay than grass surfaces but are less expensive than at first appears in view of the vastly increased use and low maintenance costs.

It is strongly recommended that floodlighting be established, thus considerably increasing their effective use.

The same all-weather surfaces can be used for association football, athletics, hockey, tennis, basketball, netball. The one game which can be played on grass only is rugby football.

As already indicated, fewer all-weather pitches are required to cater for the same volume of sport (for example, one all-weather area with floodlights is



equivalent to more than six grass areas of the same size). It should be noted that the "standard" of provision in local and district parks includes all-weather pitches, but if these recommendations for their inclusion are not accepted, then the "Space Standards" recommended in the Report can no longer apply and a much greater area should be allowed for extra grass pitches.

The district sports hall should be capable of providing indoor facilities for practice and competition in as many sporting and recreational activities as possible, for example: association football, athletics, archery, badminton, basketball, bowls, boxing, canoeing, climbing, cricket, cycling, golf, hockey, netball, roller-skating, rowing, shooting, dry skiing, squash, swimming, tennis, volleyball, weightlifting, trampoline.

Such a range of physical recreational opportunities can be administered and accommodated in the following:

Hall: 120 feet  $\times$  70 feet  
3 rooms: 24 feet  $\times$  40 feet  $\times$  20 feet high  
1 room: 120 feet  $\times$  30 feet  
Swimming room containing two tanks:  
a. 25 yards  $\times$  25 feet  $\times$  4 feet deep  
b. 20 feet  $\times$  20 feet  $\times$  16 feet deep (diving pool)  
Changing and apparatus storage accommodation.

The sports hall could be associated with further facilities of the community hall type and should include a small refreshment room. Swimming facilities have been recommended at each district sports hall, which would be complementary to the major swimming complex of Olympic dimensions already provided in the Area.

Swimming is more popular now than ever before, and is one sport which can claim family participation and which can accommodate a wide range of persons, from those keen on very active and competitive physical recreation to those seeking relaxation. It is recommended that a swimming tank be situated in a room alongside the sports hall to serve the needs of the casual bather or the learner, the accomplished swimmer or the devotee training for international events. The provision of a separate diving tank would ensure a greater degree of safety and that the area of water provided was being used to the maximum advantage over a greater period of time.

If the district park is to fully exploit its potential, it must be so managed as to provide the maximum possible service to the community. Good facilities are not enough: experience has shown that, unless they are well administered, they make little impact.

Peak use of facilities by individuals and clubs will be at weekends and on weekday evenings, but these should also be available during the day for use by individuals, shiftworkers, women's clubs (hence the creche) and schools lacking indoor sports facilities.

It will consequently seem vital that such a recreational complex should be controlled by a Director (or "Warden" or "Sports Officer") who has been professionally trained to recognise the important and increasing role of recreation and sport in society. Whilst it is envisaged that he will be assisted and advised from above and below by knowledgeable and enthusiastic amateurs, he should be a person who, by his training and sense of vocation, should be capable of taking an objective view of the whole community and the recreational activities of its population.

If sponsored by a local authority, the park could either be administered by the authority or leased at a nominal rent to a trust or committee representative of local sports bodies, who would then be responsible for day to day running and finance. The latter method has many advantages.

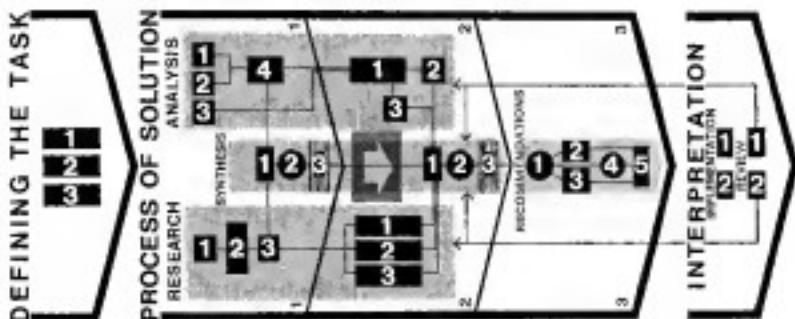
There is potential earning capacity from the provision of such sporting facilities grouped in a park, derived mainly from members' subscriptions, bookings by clubs and other bodies, catering rights, spectator events, fees for coaching courses and sales of equipment.

#### Regional Parks

Certain parts of the Area have outstanding qualities when assessed against the foregoing general principles. From them should be selected those which have the greatest potential for the development of specific facilities which need a large supporting population; or which possess unique physical advantages for specialised sports, like sailing. In addition, these parks could include those facilities associated with the three other types of park.

#### Greenway System

There are throughout the Area a number of linear elements, including the canals, drove roads and rivers, that offer many possibilities for a recreation network; one which will be dissociated from traffic, except at access points, and which will allow access to the countryside for a wide variety of activities. This system will include several functional levels, serving movement between regions and districts of the Area, as well as the local pedestrian network in residential areas.



## Final Synthesis

### 1. FORMULATION OF JOINT POLICIES

IMPLICATIONS FROM SOCIAL AND ECONOMIC STUDIES: Introduction and report—historical and geographical background—population—industry and employment—provision of commercial facilities—transport—housing—social services—entertainment, recreation and community life—public investment—fundamental costs and reclamation scheme

IMPLICATIONS FROM DATA AND ANALYTICAL STUDIES: Urban growth potential—threshold cost assessment—intensity of urban development

IMPLICATIONS FROM RESEARCH STUDIES: Towards an ideal urban environment—towards an acceptable communications network—towards a feasible recreational system—conclusions

### 2. DEVELOPMENT PATTERNS: MODEL 8

POPULATION DISTRIBUTION: The amended distribution—differences between Models 7 and 8

MODEL 8: Differences in the land use pattern between Model 7 and 8—Falkirk—Gougenhead—Larbert/Stenhousemuir/Carronshore—Denny and Dunipace—Bo'ness—Bennybridge area—Larkhall/Brighton areas

### 3. TESTING MODEL 8

SERVICES: Implications of Model 8

TRANSPORTATION: The road network—further modifications

THE DEVELOPMENT PATTERN: The green belt—industry—residential—further modifications

These three sessions present the final check and synthesis of the physical and economic studies before producing the recommended structure plan. They outline the main implications from the social and economic studies as they affect the plan, and the corresponding implications from the physical studies as revealed in the overall capacity to accommodate the population increase, in the variation of development costs of different areas, and in the definition of areas most suited to extremes of development densities. The research studies show

that a new urban framework could be created to integrate the major urban functions and create an ideal urban environment. Since more detailed studies have revealed further information, so Model 8 has superseded Model 7 and the differences are pinpointed in the main settlements. As before, the final stage is reached in testing this Model against the reactions of officials and specialists concerned with specific technical aspects and development problems to ensure that a viable structure plan can be recommended.

## Final Synthesis

### 1. Formulation of Joint Policies

#### Implications from Social and Economic Studies

As may be seen from the Planning Process Diagrams, the work of the Department of Social and Economic Research in the University of Glasgow has been carried out in parallel with the work of the Planning Research Unit. The constant interaction of thought between the two Departments has been outlined in the course of the Report, and is implicit in the process. Interim decisions, estimates and policy directions have been so woven into the fabric of the Report up to this point that it is only necessary to draw attention here to those threads in the final reports of the Glasgow team which either modified or quantified points discussed at earlier stages and already incorporated into the study. In no case has the detailed study led to an absolute reversal of policy or direction, although in some instances adjustments of emphasis arose.

#### *Introduction and Report*

(Vol. One, Chap. 1)

The confusion arising from the presence of burghs acting as housing authorities and promoting their own central area redevelopment proposals while subject to County planning authorities has more than once caused the logic of the present administrative structure to be questioned. Administrative boundaries cut through development in many places, and it seems that only sentiment will prevent the rationalisation of boundaries as expansion proceeds. Rationalisation could bring considerable benefits for planning in the Area by concentrating professional skills, and avoiding duplication of effort, and is therefore supported.

#### *Historical and Geographical Background*

(Vol. One, Chap. 2)

In the discussion of the Historical and Geographical Background to the study, it is noted that the Survey Area covered is of greater extent than the "Growth Area" defined in the White Paper on Central Scotland. Although this is technically correct, it was considered that the concept of "growth" was relevant to the whole Area, and accordingly the whole of the Survey Area is referred to as the Growth Area throughout Volumes Two.

#### *Population*

(Vol. One, Chap. 3)

There was an alteration of the overall figure expected in 1986 from 229,000 to 228,000, due to a variation in the method of calculating the in-

stitutional population. Since the revised figure is only marginally lower no further adjustments to the calculations were carried out, and thus some minor discrepancies arise between the two volumes.

Other significant factors emerging from the detailed studies of population are the large increases in school populations which could be expected, along with substantial increases in those aged 65 and over. The population of working age would increase numerically but fall as a proportion of the total. The indication that older people would form a lower percentage of the population of the Bo'ness area than of the remainder of the Area by 1986 is one example of the need for very careful phasing of community facilities which will occur locally as development proceeds.

A key factor in relation to population is, of course, migration, and movement into and out of the Areas should be documented as far as possible if detailed planning is to meet accurately the demands put upon it.

#### *Industry and Employment*

(Vol. One, Chap. 4)

The study of the employment prospects of existing industries shows that some new sources of employment will be essential since existing concerns cannot be expected to absorb the increased labour force implied by the proposed increase in population. The encouragement of new manufacturing and service industries is therefore necessary for the success of the Area. All planning means must be brought to bear to supplement the economic inducements which Government policy may make available. Adequate, easily accessible well-serviced sites and factory buildings must be prepared for any potential incomer. Because of the good accessibility of the Area relative to Central Scotland there is every likelihood of attracting industries to provide the eight hundred or so new jobs in manufacturing required annually after 1971. The multiplier effect is such that the total number of jobs would be substantially greater due to the service employment generated.

#### *Provision of Commercial Facilities*

(Vol. One, Chap. 5)

Some of the labour force would be employed in the expanding retail and commercial sector. Much of this expansion would be concentrated in the regional centre at Falkirk which has every chance of maintaining its importance as a shopping area of some 800,000 sq. ft. in 1986, and also accommodating an increase in office space of some 100,000 sq. ft.

District centres, located at Bo'ness, Camelon, Denny, Glenrothes, Greenbank, Stenhousemuir, Carronshore and Grangemouth, should cater for much of the "convenience" goods shopping and should be associated with other uses. The reservation of car parking space at these centres would require early action if the proposed hierarchy is to be realised. Only concerted action by all the local planning authorities in the Area can ensure the translation of the proposals into the economically viable reality.

#### *Transport*

(Vol. One, Chap. 6)

Transport will be a key factor in the development of the Area. The regional centre at Falkirk should be encouraged to develop around the focus of the rail transport network at Grahamston, and the road network should foster this approach, with greater emphasis on public transport for journeys to the regional centre than to the district centres, if maximum return is to be obtained on the present investment in the centre of Falkirk. Some early improvement of the regional road network is necessary because of the increase in traffic anticipated between the docks at Grangemouth and all parts of Central Scotland. The schemes already proposed and approved should help to cater for external traffic, and internal traffic would require to be guided on to an improved network.

#### *Housing*

(Vol. One, Chap. 7)

In so far as the Housing Survey produced little evidence of a wish for home ownership amongst the present population, the demand for middle income housing may be rather less than was at first thought probable. But the demand will be influenced at every stage by the policies of the local authorities on rents, and by the number of immigrants from areas with a higher proportion of home ownership. Therefore some potential sites for such houses should be reserved for the later phases, even if otherwise suitable for early development.

#### *Social Services*

(Vol. One, Chap. 8)

The social services described are for education and health facilities. Both require high capital investment and some advance consideration of needs is essential if provision is to keep step with demand.

The numbers of school children in 1986 implied by the population projections are: Primary—34,200; Secondary—19,600, representing roughly double the present provision. Their distribution will depend on the educational policy adopted by the local authority, but a move towards greater comprehensiveness is likely in view of the Government's present policy. The demand for part-time education for non-academic school leavers will increase and the equivalent of nine hundred places would be required for this purpose by 1986.

In the welfare sphere the need will be for increased provision of services, enabling the elderly to remain as far as possible in their own homes rather than in institutions. Sites would be needed for health centres for general practitioners and a Family Doctor Diagnostic Centre which could be developed experimentally in Falkirk. Clinics and welfare services are of great importance in areas of growing population and adequate sites with easy access should be made available when required.

Additional hospital beds required by 1986 will

number around three hundred and seventy five acute, maternity and geriatric cases, and around three hundred and twenty-five for mental illness and mental deficiency. Demand may outstrip provision by 1976 but may be met by additional beds rather than by a whole new hospital complex.

#### *Entertainment, Recreation and Community Life*

(Vol. One, Chap. 9)

Points emerging from the study of recreation and social organisation are the under-provision of social buildings in the Area at present, and the need for co-ordination of efforts to improve provision.

Sites for libraries linked to shopping areas and with meeting halls incorporated are suggested for Brightons/Pontmaitt, Carronshore, Glenrothes and Greenbank.

It is further suggested that 11·5 acres per thousand population will be needed for physical recreation. This is however accepted as only part of the problem as type, quality, distribution and administration are as important. The needs of young people should be carefully considered since the proportion of under twenties will probably rise from 33·3% in 1961 to 41% in 1986.

#### *Public Investment*

(Vol. One, Chap. 10)

Expenditure involved in the proposed expansion of the Area will be high, and techniques of appraisal of investment will need to be developed along with the techniques of planning. Many types of planning proposals have important repercussions on the cost of public investment; these primarily concern density, design, location of different types of development, and the broader aspects of socio-economic, occupational and age distribution groupings.

A further study of density/costs relationships in this Area could be most useful to supplement the initial exercise on thresholds described in this volume in Phase 2 Data and Analytical Studies.

#### *Foundation Costs and a Reclamation Scheme*

(Vol. One, Chap. 11)

The study undertaken of foundation costs disclosed that any additional costs arising from the use of unstable ground was not large enough to deter development. Therefore there was no need to consider the low bearing capacity of the ground in the valley of the River Carron as a serious limitation to development. The study was restricted to land of low bearing capacity and did not cover land liable to subsidence, which may give rise to additional costs.

The high cost of land reclamation is likely to prevent future growth towards the sea in the Grangemouth/Bo'ness district.

#### *Implications from Data and Analytical Studies*

The Data and Analytical studies in Phase Two had several aims; to check on the distribution of land uses in the development structure of Model 7; to assess the long term population potential, both physically and economically; to determine the priorities for development; and to define the intensity of development of these areas from the most satisfactory economic and environmental viewpoints. The general implications from these studies as affecting Model 7 will lead to Model 8.

## *Urban Growth Potential*

The overall population potential is limited. Although various interpretations can be made of certain adverse factors, post 1986 development cannot be extensive unless densities are increased considerably. A population increase of 190,000 could be accommodated and 4,650 acres made available for new industry, to give an Ultimate Growth Potential of approx. 310,000 population. Expansion beyond this population figure would be undesirable. There is unlikely to be a shortage of industrial land, because of the extensive reserves at Skinfolds and the industrial proposals in Model 7 which satisfy most needs beyond 1986.

There appear to be few limitations to expansion of the infrastructure network. The ultimate capacity of committed new sewage treatment plants (together with existing works) corresponds to the Ultimate Growth Potential target. The extensive water resources will easily meet the demand. Extensive surface drainage networks are also possible and are unlikely to limit urban expansion. There are congested sections of roads in some urban areas which could be improved. However, the new urban structure required for the expanded population will in any case necessitate an improved communications network. The most severe limitations to population expansion come from topographical and climatic factors and only a limited number of these can be reasonably modified.

Growth potential possibilities in existing urban areas are not extensive, and would neither change nor expand the existing land use pattern to any great extent but these pockets may be useful for early implementation of the Plan. The largest areas of vacant land lie mainly at the edges or between settlements. Urban Growth Potential findings generally confirm the validity of areas chosen for development in Model 7.

## *Threshold Cost Assessment*

This study shows certain aspects of economic potential of areas for residential and ancillary uses. First Threshold Costs would not be a limitation to development. The next cheapest Threshold areas should be developed but in a sequence related to the phasing of population expansion.

The general comparison of Threshold Costs (see Diagram V, "Threshold Costs Comparison") for each town group shows that the best return could be expected if Larbert is developed. It has the most significant growth potential and the additional investment costs are relatively lower. This would not be the case at Bo'ness, where there is also a substantial potential. There are opportunities for a major expansion at Airth but, since this will entail the creation of a new community of at least fifteen thousand people, initial costs will be high and other areas with similar costs and characteristics, but with better locations, should be exploited first; at Larbert, Falkirk south and Denny.

## *Intensity of Urban Development*

Physical, social and planning factors all influence the intensity of urban development within the overall densities chosen. For residential functions, the areas clearly defined as more suitable for lower densities show that the population capacity in Kincardine House/Carrenhouse area is not as high as suggested in Model 7. Parts of Glenboe and areas east of Denny are also more suitable for lower densities. On the other hand, development south of Falkirk at Greenbank could be at higher densities, suggesting that the population could be accommodated in a smaller area nearer the regional centre.

Areas at Bonesshouse (south of Grangemouth) and Bonessettors (south of Bo'ness) are also suitable for higher densities, as are possible redevelopment sites associated with central areas. Large flat areas would be most suitable for manufacturing industries with very low employment densities (i.e. capital intensive industries), so that it would be advantageous that Skinflats should be held in reserve for a major concern. Because of ground and climatic conditions, Bonnybridge industrial area would be generally more suitable for intensive industries which need smaller sites at higher employment densities. Whotfolds (Grangemouth) would be suitable for lower densities and could provide larger sites. Any noxious industries should be sited close to the coastline. The policy of placing small sites close to urban areas to satisfy local employment needs, accommodating higher employment densities, could usefully be extended.

## *Implications from Research Studies*

The Research Studies into possible new development patterns deal with specific aspects of the main urban functions. The results achieved provide the framework for the more detailed proposals for urban development and will be instrumental in refining the chosen Development Model.

## *Towards an Ideal Urban Environment*

The proposed structure of residential areas will attempt to create the optimum conditions, and to provide adequate services for the efficient functioning of family and community life. An hierarchical structure would be built up from a series of Basic Residential Units within Environmental Areas, and located within catchment areas of local shopping centres, primary schools and district shopping centres. Pedestrian movement would be facilitated by controlled and separated traffic circulation and it is hoped that good design would provide aesthetically stimulating and functional surroundings. These aims will be best achieved in new residential development. Advantage should be taken of the opportunities to revitalise the existing residential areas, where these no longer measure up to acceptable environmental standards. Revitalisation should aim to control traffic nuisance, facilitate pedestrian movement, improve amenities, and rationalise land-use, but should nevertheless be undertaken within cost/benefit limitations. Redevelopment should take place comprehensively and as a means of implementing the new urban structure.

An hierarchical distribution of shopping centres would be built up from the simplest facilities at local level, to the regional commercial centre which would be the focus of the Growth Area. An even distribution of catchment populations should be aimed at to give a satisfactory range of facilities and convenient access, especially for pedestrians. The character of shopping areas should be attractive from the view-points of safety, convenience, visual surroundings and access to transport facilities.

## *Towards an Acceptable Communications Network*

The proposed increase in population, and the expected rise in vehicle ownership/use rates underlines the need for a comprehensive approach to a solution to the conflict between accessibility and environment. An hierarchical system of road networks would be needed, each related to specific traffic functions, and ranging from the local residential road to the fast national system with limited access. A good standard of public transport should

be aimed at, based on the reorganisation of existing rail and bus services, in order to offer an attractive alternative to the private car. The average journey-to-work distance, however, should be within a 2½ mile radius, similar to that at present.

The peak hour flows of the journey from work pinpoint a concentration of activities in central tertiary employment areas and around the main manufacturing area. Although the design of the road network would be based on desire lines, the chosen pattern would seek to balance commuter flows within the Growth Area and to control the attraction towards inner central districts, in order to achieve an acceptable scale of roads and a circulation pattern which would preserve the amenities of environmental areas.

#### *Towards a Feasible Recreational System*

A rising demand for recreational facilities may be expected. The type of places and events to provide recreation should be compatible with present day social needs and should not be based solely on precedent. Their selection should be guided by certain principles covering the administration, user requirements, accessibility, attractability, flexibility to accommodate change and expansion, exploitability and capacity for use.

To cater for all age groups of the population with their varying degrees of participation and mobility,

a graded system of recreational facilities will be needed. Places to which people go would be provided for by parks, ranging from the simplest level of Children's Park in each Basic Residential Unit, to the Regional Parks serving populations from wide areas. Movement through the Areas would be catered for by a regional pedestrian network or greenway system taking advantage of linear elements of the landscape and natural features, and from this would branch local systems linking urban districts and environmental areas. Sites of architectural, historic and scientific interests would also be served by this system.

#### *Conclusions*

Studies of these three main urban functions show that design and provision of facilities would be on an hierarchical basis, each framework closely interrelated with each other. This would ensure a consistently high standard of environment and a wide range of community facilities and recreational opportunities in all urban areas, which is at the same time a viable physical and economic proposition. The definition of Environmental Areas would protect the amenities of residential areas in particular but would also allow a more rational network of communications serving all scales of movement. These frameworks would therefore provide a unified approach to urban development.

## 2. Development Patterns: Model 8

More refined demographic projections and detailed estimates of land needs based on the foregoing studies have led to the need to modify the original development Model 7. These modifications show that the former monocentric emphasis has shifted and there are now some affinities with the polymonocentric model, although Falkirk would remain the regional centre.

More intensive urbanisation of the area around Falkirk and Grangemouth has been achieved but the smaller peripheral communities such as Bo'ness and Denny would continue to play more isolated roles. Other scattered residential areas have only been expanded where particularly suited environmentally. The extensive problems of subsidence in areas of past mining activities have restricted development in some districts and lowered densities in others. The traffic circulation pattern has now been considered on a hierarchical basis serving all parts of the Growth Area.

#### *Population Distribution*

Projections of the population (see Volume One Chapter 3) have given a rounded-off figure of 229,250 by 1986. This figure and more detailed studies on land use led to the following amended population distribution.

Area	Population for Model 8	Population for Model 7	Difference
Falkirk . .	65,250	65,000	- 1,750
Grangemouth .	37,500	30,000	- 2,500
Lothian/			
Stirlingshire	51,750	40,000	+ 11,750
Denny, etc. .	29,750	40,000	- 10,250
Bo'ness . .	24,000	24,000	0
Bonnybridge .	12,500	13,000	+ 500
Lauderston, etc.	20,500	20,000	+ 500
Total . . .	229,250	231,000	

#### *Model 8*

Model 8 can be best described by pinpointing the differences in the distribution of land uses between Model 7 and Model 8, and by reference to the main urban areas. This is shown on Maps No. 63, "Model 7—Modifications", and No. 64, "Model 8".

#### *Falkirk*

Little change is proposed. For environmental reasons some reduction (-1750) in the proposed residential development south of Glen Village is necessary to prevent development south of the district distributor road. Glen Burn indicates the desirable limit of residential expansion at Greenbank. More detailed studies have revealed the possibilities of small areas of infilling and redevelopment within Falkirk itself. Generally, proposals have been further rationalised and densities slightly increased because of proximity to both regional and district centres. Industry within the proposed central park should be relocated when possible. Committed proposals for infilling are approved at Shielhill, but no further development should be envisaged here or in the other small villages on the periphery because of exposure, difficulties of access and problems of providing satisfactory community facilities.

#### *Grangemouth*

The population should be reduced by 2,500 by lower densities on the remaining available residential land. Further expansion towards the tidal beach is undesirable since existing and proposed industrial areas lie close by. Existing residential areas at Glesmough, and north of Bo'ness Road have unsatisfactory environments due to industrial surroundings and these could be redeveloped for industry at the end of their useful life. Skinkie village will be in the same situation when adjacent land is developed for industry. Industrial land



**Map No. 83: Model 7—Modifications** Key: 1. Existing residential development. 2. Proposed residential development. 3. Existing industry. 4. Proposed industrial sites. 5. Regional shopping centre. 6. Recreational system. 7. Woodlands. 8. Improvement areas for agriculture, forestry and recreation. 9. Major roads. 10. Railways. 11. Rivers and canals. 12. Airspace. 13. Land to be held in reserve for major new industry. 14. Area of possible land reclamation. 15. Oceans. 16. Additions—residential development. 17. Additions—industry. 18. Additions—open space.



**Map No. 84: Model 8** Key: 1. Existing residential development. 2. Proposed residential development. 3. Existing industry. 4. Proposed industrial sites. 5. Existing and converting major shopping centres. 6. Hospitals. 7. Existing private open spaces. 8. Area for development of residential facilities. 9. Woodlands. 10. Land to be held in reserve for major new industry. 11. New major shopping centres. 12. National roads. 13. Primary distribution. 14. District distribution. 15. Existing and proposed open space. 16. Green ways system.

should be restricted at Wholdists to that served by the district distributor. Further land at Skinfalls should be developed for industry as well as the committed sites along the Caren River, but limited by the motorway westwards. On the east side a green strip would be retained along the foreshore. A new golf course is proposed at Newlands between Grangemouth and Larbert.

#### *Larbert/Stenhousemuir/Carronshore, etc.*

The population is increased by 11,750 (accommodating some population previously assigned to Denny) achieving the stated policy of integrating and intensifying the urban areas. Residential expansion should mainly be located at Gilmerton/Kincardine and on the existing town golf course. This golf course was thought to be uninteresting, and being close to the district centre and physically suitable it should be re-zoned for higher density housing. At this scale of development, community facilities, new drainage schemes and access could be provided comprehensively. Expansions of the hospital zone east and westwards should preserve this area against development for other uses. Kincardine House, an attractive site, is re-zoned as a golf course to replace the Tryon ground. The population should be reduced in Carronshore due to the unsuitable ground conditions. An extension to the existing industrial area is proposed by re-zoning an adjacent small poor housing area at Larbert Cross which is already separated from other residential development by the railway line. The northern section of the M9 should now by-pass Fife on route to Stirling on an improved alignment. There should no longer be an interchange between the old A9 and the new A876 at Gilmerton in order to discourage use of the national roads for journeys solely within the Area. Previous expansion proposals for Alirth have been found unsatisfactory because the scattered nature of development makes for uneconomical provision of facilities. This area could be more suitable for long term industrial expansion.

#### *Denny and Dunipace*

Population expansion should be curtailed by 10,250 in the Torwood area north-east of Denny because of committed proposals for routing high tension overhead electricity cables through the Area, which would result in discontinuity of development for visual and physical reasons. Development nearest the town should also be restricted in the proximity of the expanded industrial sites along the River Caren. Instead, residential development should be extended slightly northward up to the crest of the hill, and southwards in the committed burgh extension area to the natural barrier of Glowlinton Wood. A non-conforming industrial site could be re-zoned on the

north bank of the River Caren to provide high density housing close to the central area. Proposed residential land should be curtailed at Mydburn since it is more suitable as an additional site for industrial development. Access direct to Denny from the motorway at Ingleton should not be allowed as suitable alternative access exists for through traffic, Grangemouth and Larbert.

#### *Bo'ness*

No amendments are made to the population proposals. Industrial land should be reduced along the foreshore since rehabilitation problems will delay development, and because these areas would be better considered together with any proposals for reclamation of adjacent mud flats post 1986. Present industrial sites around Grangemouth should be extended and rounded off westwards. A small alternative site is proposed at Borrowstoun and is immediately available for development of very light or service industries. This would also help split journey-to-work flows and relieve the congested section between Bo'ness and Grangemouth.

#### *Bonnybridge area*

Little further increase (+500) except where infilling proposals are already committed. Residential development should be restricted to the east of industrial sites. Where land uses are mixed, housing should not be renewed at the end of its useful life, e.g. Longcroft, and High Bonnybridge. The new industrial estate should be curtailed slightly in the valley to safeguard a greenway along the canal and the Antonine Wall, and because of the road alignment of the new district distributor. No further industry should be sited at High Bonnybridge adjacent to the housing. Because of rehabilitation problems and difficult gradients, the Bonnybridge site would be most suitable for innoxious industries needing smaller sites.

#### *Laurieston/Brightons area*

Little change is proposed to the previous population figure (+500). However, the distribution of new residential areas should be slightly amended because of difficult gradients, and to preserve a band of agricultural land between the motorway and Larbert, and along the Antonine Wall. The main residential additions should be at Polmont, which will be limited by the alignment of the primary distributor road. Further detailed studies have shown the desirability of rounding off and infilling in some areas where development is scattered (e.g. Brightons). A small site of poor and scattered housing should be re-zoned for service industries on the old Redding road (adjacent to the railway line) which is already cut off from other residential areas by the new A801 alignment. A further golf course is proposed at Knowlehead (south Callander).

### **3. Testing Model 8**

The Regional Development Model 8 was presented to the Technical Committee, the Working Parties, the local authority officials and government officers for their comments and advice in the same manner as Model 7. The proposals in Model 8 modified Model 7 in several ways and were the result of further studies and problems thrown up by Model 7. Therefore, observations on Model 8 were less concerned with major proposals and more with matters of detail and presentation. The main comments on the Model were as follows:

#### **Services**

Since the Threshold Study has ensured an efficient use of services, the final figure for water supply and drainage would derive from detailed design based on the modified population.

#### **Transportation**

##### **Roads**

The work of the Transportation Advisory Group had been the basis for the road network and most

commuters were confined to exact alignments of the routes. Better access would be needed for industrial traffic in the Boxxybridge area to the A50 and for commuters from Cambersfield. The change from a two-way inner ring road to a one-way flow ring road at Fallowfield Centre was accepted as an improvement on the original design. However, it was considered that the access into the town at Glenbrae from the primary distributor should be restricted to prevent high traffic volumes on this difficult gradient. The dangerous crossroads at Salmon Inn was still a problem and depended on an agreement on the role of the existing trunk A5. Importance of programming was stressed as an aspect for further study and would depend on the classification of the routes. There was a request to retain Denby's short link with the A50. The road access to the industrial areas at Skindale was severely criticised for splitting up sites haphazardly and it was agreed to amend the road pattern at this point.

## Development Pattern

### *Green Belt*

Although there was still some disagreement about development in the green belt, the proposals were

generally accepted on the understanding that the type of industry would be controlled, i.e. light manufacturing, and providing a regional greenway was safeguarded between Falckirk and Grangemore.

### *Industry*

It was considered that industrial development should be restricted to sites east of the distributor road at Skindale. At Denby it was suggested that industrial land near the centre could be re-zoned eventually for housing and the estates proposed at Myddle extended to replace the loss.

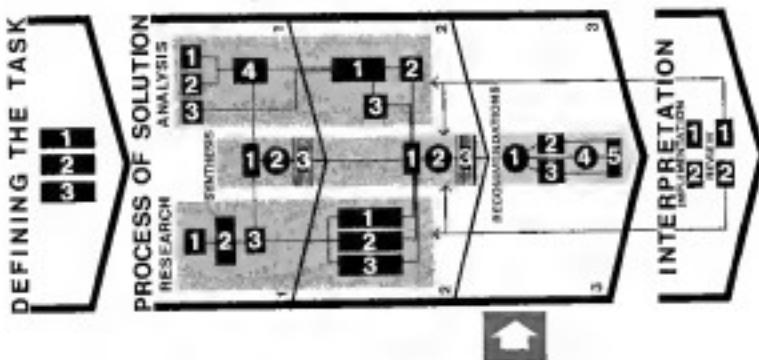
### *Residential*

Objections were raised to development at Kinnaird on the grounds of landscape value and possible drainage and access problems. However, it was considered that these could be overcome economically because of the large scale of development envisaged, and with consequent advantages over other alternative areas such as Deanscore and Kinnaird House.

These and other more detailed observations enabled improvements to be made to finalise the Urban Structure Plan based on this Model.



## Process of Solution — Phase Three



### Recommendations

Following minor modifications to Model 8 arising out of consultations with government authorities and technical experts, the recommended Structure Plan for the Grangemouth Falkirk Growth Area was

completed. The population distribution is closely bound up with the physical and economic development possibilities, but is also guided by the environmental quality desired for each part.

#### 1. GROWTH AREA STRUCTURE PLAN 1986

#### 2. LAND USES AND ENVIRONMENT

- SETTLEMENTS
- AGRICULTURE
- FORESTRY
- RESIDENTIAL
- COMMUNITY FACILITIES
- INDUSTRY
- MINING AND SUBSIDENCE
- RECREATION
- REHABILITATION

#### 3. INFRASTRUCTURE

- PUBLIC UTILITY SERVICES
- COMMUNICATIONS

#### 4. LONG TERM PHYSICAL GROWTH (BEYOND 1986)

#### 5. CONCLUSIONS



## Recommendations

### 1. Growth Area Structure Plan 1986

An urban complex supporting a population of about 230,000 is proposed, focusing on Falkirk as the regional centre, stretching from Denny in the west through Larbert/Stenhousemuir, to Falkirk and Grangemouth in the east. Bo'ness would remain a separate unit but would also be dependent on Falkirk as the regional centre. A more scattered development would focus Link, Larbert, Polmont, Redding, Westquarter, Polmont Station and Brightons giving a rural character to these urban areas. Other much smaller developments would concern isolated villages mainly on the periphery. The main elements of the proposed urban structure are as follows (see Map No. 65, "Structure Plan—Analysis of Land Use," Figs. A-E).

#### *Residential and Ancillary Uses*

Residential development would be sub-divided into Environmental Areas served by local shopping and community facilities. The main new residential area would be located north and east of Larbert/Stenhousemuir, north of Denny, south of Falkirk, south of Bo'ness and south-east of Grangemouth. There would also be some infilling development and small expansion of the Larbert/Brightons complex. Falkirk would remain the largest residential concentration, but the major new development would be around Larbert/Stenhousemuir (see Fig. A).

Falkirk would continue to be the regional shopping centre and each of the other main residential areas would be served by district shopping centres, three of which would be new. Each centre should also contain a limited range of entertainment, social and other related commercial facilities, but Falkirk Central Area would offer the widest range of activities. Educational facilities would be distributed evenly to suit the Environmental Area patterns, thus obtaining the most satisfactory catchment areas for primary schools. The small physical expansion foreseen in health services would concern mainly the provision of health centres. The area zoned for hospitals in Larbert would be extended to preserve the amenity of the area for patients rather than to provide for any large-scale expansion of buildings.

#### *Industry*

Two major industrial concentrations are envisaged: (1) a large compact area at Grangemouth around the docks and westwards to Falkirk for the bigger concern, with a reserve area for a "special" large-scale industry north of the River Carron at Skinfold; (2) in the south-west adjacent to Bonnybridge, an area suitable for smaller light manu-

facturing industries. In addition, small local estates would be available at Denny, Larbert and Bo'ness for light or service industries (see Fig. B).

#### *Recreation and Open Space*

A large regional park bordering the River Carron is proposed in a central location soon surrounded by development. A network of regional pedestrian greenways would follow the main linear natural features to provide a link with other large-scale recreational areas at the edges of the urban complex and with places of historic interest (see Fig. C). The main directions of movement would be along the River Carron, the A822, the Canal, and foreshore, passing through and between the urban areas.

#### *Agriculture and Forestry*

Land at the edge of the Stirlingshire Plateau would be improved for multi-purpose use including agriculture, forestry and recreation. Protection for settlements at high altitudes would be given by extensive shelterbelt planting. Non-arable land in the Duntry/Kilgray Hills does not warrant the same intensive improvement, but public access to certain areas would be desirable for recreational use.

#### *Road System*

These national-scale traffic routes would link with the rest of the Central Belt of Scotland and also lead towards Fife and the north. Within the Area, traffic would be accommodated on an hierarchical network of roads (see Fig. D). Primary distributor routes of urban motorway standard would provide the major circulation pattern, linked to the national routes at limited intervals, and giving access to the main population centres at Falkirk, Grangemouth, Larbert and Stenhousemuir, and to the main industrial concentrations. District distributor routes connected to the primary distributor system would cater for major flows within urban areas and would give access both to Falkirk Centre and to all district shopping centres. All local road networks serving residential areas would be linked through the district distributor system to deal with the flows generated within Environmental Areas.

#### *Integrated Physical Structure*

The integration of these main elements creates the proposed physical structure (see Fig. E and Map No. 74 "Structure Plan 1986"). The detailed allocation of major land uses follows in Table 1.

TABLE 1: *Proposed Land Uses\* (acres)*

	Residential (net)	Industry (mainly Manf.)	Recreational Open Space (excl. golf courses)	Other Uses†	Total
Growth Area	2,375	1,460 (excl. Skinfalls)	1,270	900	6,005

\* Rounded off.

† Including schools and associated playing fields, shopping centres and general area facilities, hospitals, and incidental open space, but excluding golf courses.

The total built up area would be of some 13,780 acres, giving an overall gross urban density of 10.2 ppa (excluding golf courses and docks). Assuming the net increase in total population 1965-86 to be some 102,550 persons (see Volume One, Chapter 3), then the gross urban density for all new development will be 17 ppa or, excluding industry, 23.5 ppa. Land held in reserve at Skinfalls for industrial development covers almost one thousand acres.

#### Population Distribution

The demographic projections estimate a total population of some 229,290 persons by 1986. Of this total 206,150 persons are located in the main urban areas, and 23,100 in the landward areas and villages. The following table shows the population distribution subdivided into the census Districts of Counties:

TABLE 2: *Population Distribution*

		1961 Population	1986 Population	Increase 1961-86
Falkirk	...	36,044 (Burgh) +1,743	65,250	24,606
Grangemouth	...	18,857 (Burgh) +1,233	23,500	7,413
Larbert/Stenhousemuir (plus Alloch and Dunmore)		16,877 (Burgh) +1,726	51,750	33,167
Denny	...	7,760 (Burgh) +1,068	29,750	20,992
Bo'ness	...	13,857 (Burgh) +230	24,000	9,793
Levenston, etc.	...	13,691	20,500	7,809
Bonnybridge	...	10,063	12,500	1,537
TOTAL	...	124,167	239,250	105,083

## 2. Land Uses and Environment

### SETTLEMENTS

This section broadly describes the proposed relationships and character of the urban areas and their urban functions. More detailed proposals for individual land uses are described in later sections.

#### The Character of the Urban Areas

Since a closer knit urban complex has now been proposed it is difficult to isolate individual settlements. The new urban areas are not necessarily contained within present recognised spheres of influence (e.g. the Burgh boundary) and new development often strengthens or forges links between existing Burghs. Nevertheless for convenience the components of the new urban structure will be identified as before.

#### Falkirk

Falkirk would continue to be the commercial centre of the Growth Area. Expansion to 65,250 would be achieved mainly by new development located south of the present Burgh boundary, and by redevelopment of some central sites. Existing links with Larbert/Stenhousemuir to the north, and Grangemouth to the east would be strengthened by

further infilling, by extensive new industrial development, and by good accessibility from the primary distributor circuit route. The population expansion should increase the importance of both the High and Grahamston railway stations, especially the latter which has a favourable position adjacent to the town centre and good commuter services available to Glasgow and Edinburgh.

The main new residential areas would be located at Greenbank and southwards to Glen Burn, within and south of Callendar Park. The main residential redevelopment areas would be adjacent to the town centre and southwards, around Wallace Street and Ladymill. As well as the regional centre focused on the High Street there would be district shopping centres at Greenbank and Camelon catering for local needs. The High Street, freed from vehicles, would become the spine of a pedestrian network within the central shopping area. Further office development would be expected to be attracted to areas near the new Council Offices and areas towards Camelon which allow satisfactory access to the district distributor road network.

Industries are scattered throughout Falkirk and those sited in residential areas should be removed where possible; and steps should be taken to reduce



Fig. A  
Residential and Main Shopping Centres



Fig. B  
Major Industrial Concentrations



Fig. C  
Recreational System



Fig. D  
Road System



Fig. E  
Synthesis

the pollution and other environmental nuisances at source. Main industrial expansion would take place between Falkirk and Grangemouth at Middieldfield and West Mains by extending existing industrial areas towards each other. Several industrial concerns on sites immediately adjoining the Falkirk Central Area should be relocated. This area would be better utilised in the long-term for high density housing. The brewery within the central area should also be relocated in the long term and should be replaced by commercial uses (details of the Central Area proposals are expanded in the section "Process of Application"). A site at Lochlands is already committed for industrial development.

The proposed central park and lake adjoining the River Carron would be the focus for pedestrian routes and greenways circulating through Falkirk. The Antonine Wall and both canals would provide the main directions of movement, linking Callendar Park and the proposed district park at Rough Castle.

The new road network would provide access to Falkirk from all parts of the Growth Area via the primary distributor circuit. The Centre itself would be contained by a one-way district distributor ring road which would serve major car-parking and servicing facilities. The areas ripe for redevelopment would give opportunities to improve some existing major routes and to upgrade the environment of adjacent residential areas.

#### Grangemouth

Grangemouth would be expanded to a population of 25,000 (excluding Skinflats) by the development of the remaining designated residential areas by 1970. Links with Falkirk would be strengthened by the expansion of existing industrial areas between the Burghs and by improved road links. The Burgh would play a more important role in providing employment than in accommodating immigrants since population expansion after 1970 could be catered for in the Polmont area.

Major new areas of housing would be built at Bowhouse, limited to the south by the new motorway and to the east by the district distributor road. The main redevelopment areas are associated with the committed town centre redevelopment at Lumley Street, which would provide the only district shopping centre for the Burgh in spite of its eccentric location. Two small areas of housing at Glensburgh and north of Bo'ness Road suffer from poor environment and are adjacent to noxious industries. This would be aggravated by completion of the road system, and these areas should be re-zoned to industrial use in the long term.

Industrial areas would be expanded eastwards (including land already owned by the petrochemical companies) nearly up to the line of the raised beach, but limited to the south by the district distributor road at Whieldrake. A green space will provide separation from the adjoining residential areas to safeguard their environment. Major new industrial areas are proposed between Falkirk and Grangemouth at Middieldfield and West Mains, stretching westwards from the new M9 motorway to provide regional employment. A large area in Skinflats is also reserved for some large scale development. Where possible, the effects of pollution on housing areas from existing industries should be substantially reduced.

Pedestrian greenways from the existing Burgh park would be extended to link with the regional network and the new golf course at Newlands. Access along the foreshore would be maintained except around Grangemouth itself where the route would run inland, through the former Green Belt. Although the Green Belt would now be greatly

reduced, a greenway would be safeguarded as part of the pedestrian circulation through the urban areas, and to prevent too close a proximity between the industrial and the residential areas on the eastern side of Falkirk.

The road network is designed to link the industrial areas of Skinflats, Whieldrake and Bo'ness, with direct access from the primary distributor circuit route. Thus, volumes of heavy commercial traffic at present passing through many residential areas would be re-routed. Local traffic would be adequately served by the district distributor network skirting the residential areas.

#### Larbert/Stenhousemuir/Carronshore/Torwood/Kinnaird

This major new urban complex would continue the urbanised zone northwards from Falkirk. The population target would be 56,750, achieved mainly by new development with very little infilling except south of Larbert and around Stenhousemuir. Any possible disadvantages from the upgraded A876 road bisecting this new urban area are lessened by the natural break in the dense urban pattern caused by the existing hospital zone. Nevertheless, good road access to the regional centre and other urban areas would be ensured. There would be five major new residential areas: Carronshore, Glenbervie, Kinnaird, Torwood and Antonhill, extending north, east and north west of the present built up areas. Antonhill would develop part of the Tryt golf course. There would be three district shopping centres (including that at Stenhousemuir committed to be redeveloped shortly). Outlying areas at Torwood and Glenbervie are expected to be attractive for middle-income development. The hospital zone would be extended east and west to preserve the amenity of the area and to hold land in reserve for any possible long term major development.

Little additional land is proposed for industry except for infilling and extending the existing area at Larbert Cross southwards between the railway line and the A9 trunk road, by re-zoning an existing poor housing area. The other existing industrial site at Carron produces both visual and physical nuisance to the environment of the surrounding residential area and improvement is long overdue. Pockets of small non-conforming industries should be gradually re-located in the new industrial estates.

A new golf course is proposed at Kinnaird House to replace the Tryt ground. Major greenway routes would link the existing parks southwards through the urban areas with the new central regional park, and northwards to Torwood.

Traffic from this district to the regional centre would be encouraged to use the primary distributor network to avoid congestion on internal local distributor routes in Falkirk. A series of links across the primary distributor circuit route would serve the residential areas and district centres, and the local residential road network would also link Airth village to Carronshore and Kinnaird.

#### Denny and Dunipace

The population in this district would be expanded to reach 22,750 to strengthen its relationship with the other urban areas to the east. Most of the new development would take place north and east of the present Burgh, with infilling on the western boundary along the motorway.

The major new residential areas would be located towards Dales Wood, limited northwards by the crest of the hill and eastwards by high tension overhead electricity cables. Some urban renewal is possible east of the town centre. The town centre,

shortly to be redeveloped and extended, would provide the district-level shopping facilities. A non-conforming industrial site along the River Cawen near the centre should be re-used in the long term for housing. Secluded residential areas lying farthest north of the district centre should prove attractive for residential reuse development.

Industrial land would be restricted mainly to the east of the disused railway line and would fall around existing industrial areas adjacent to the River Ceron. Expansion southwards around Myndub and the existing metal works would be limited by the district distributor, including an area held in reserve.

The greenway network through the urban areas would be closely associated with the River Carron and its tributaries, and would link with the existing Burgh parks, and thence towards large areas of semi-natural areas in the Kintyre Hills.

The district distributor road network would provide an outer ring and 'bypass' to the Brough to discourage traffic passing through the central area, and to link development effectively with the regional network. Access to the national routes would be via the primary distributor for journeys out of the area, except to Stirling where the existing trunk road could be used.

Bo'ness

Bo'ness would continue as a separate self-contained unit but looking to Falkirk as its regional centre. It would be expanded to 23,000 by 1986, mainly southwards, and proposals now approved by the Secretary of State to relocate the town centre at Douglas Park would effectively encourage Bo'ness to "turn its back" on the firth.

The major new residential areas would stretch south of the present built-up areas from Kinsella to Munhouse. The new centre would offer district scale shopping facilities and would be more central for both existing and proposed residential areas. Most redevelopment should take place at the lowest levels adjacent to the Grange Park development.

Industry would continue to be located mainly along the foreshore, and some of the inland industrial areas should be improved for development. An alternative location proposed for some small light or service industries at Borrowman would be immediately available.

The old harbour and docks would provide the nucleus of the proposed marine recreational centre, and associated development, such as small boat repair workshops, ship's chandleries, cafes, etc., would be located in the former town centre area. It would provide regional recreation. Pedestrian greenways would form a network using existing open spaces along the steepest slopes, and providing links to the nearby buildings of historic interest, the marina centre, and via the Antonine Wall to the other towns.

The road network proposal is in the form of a district loop giving access to the town centre from the residential areas, and also a local by-pass route along the forecourt serving the industrial areas and linking with the rest of the regional network.

### *Lawerton-Brighton Area*

This series of linked settlements would be expanded to a population of 16,500 but would preserve its rural character by the nature of its topography, interspersed green areas and recreational open space. For these reasons it would not have a clearly defined centre.

The major new residential areas would be at Polmont, Salomon Inn and Brightons, the latter being mostly infilling. It is expected that areas of Polmont would be especially attractive for executive housing in view of the easy rail connections with Edinburgh.

and Glasgow from Polmont Station, and its convenient access to Grangemouth's industrial areas. Limited redevelopment of the shopping centre at Larbert and the proposed small centre north of Polmont Station would provide for everyday shopping needs.

Very little manufacturing employment would be available in this predominantly residential district. A small site for light manufacturing or service industry is proposed at Old Redding Road, Luton. The existing explosives works would be redeveloped at Redding Marshes for a similar purpose. Some service employment already exists, mainly in institutions.

Two parallel sections of the regional greenway network would lead through this area: starting in Laramie along the Anterior Wall to Callander Park and branching to Gageborough; and following the Union Canal. Links between these routes would run along Glen Burn. A new golf course is proposed at Knowlehead.

The new regional road network should relieve those parts of the district suffering from traffic nuisance. Access from the primary distributor roads would be at Folkestone Station and Callendar Park, and there would also be convenient access via the district distributor network to Gravesend and Faversham.

### *Cutting Settlements*

These include the villages of	
Shieldhill	Banksnock
Californian	Hegg
Airth	Dunmore
Stonywood and Fankerton	Bonnybridge
Steinkirk	High Bonnybridge

The total population for the landward areas including all these scattered settlements would be 25,100. In general there would be little expansion except on sites already committed for development, which are mainly at Boxleybridge and Sheldwell. The intra-environment is unsatisfactory in many of these areas and proposals are made to counteract air pollution at High Boxleybridge, and the climate at Sheldwell and California.

Bonybridge would be the most self-contained of these villages, having a local shopping centre. At Bonybridge the present scattered industrial areas should be centralized and expanded west of the village to provide a second major industrial concentration. Housing areas at present in a poor industrial environment in High Bonybridge should be phased out in the long term.

Most of these settlements would continue to be served by existing minor roads, but the Bonython bridge industrial site would be served by a distributor network for its industrial traffic and would be linked by the primary network to the other major industrial areas.

The recreational greenways would pass close to many of these villages to link areas of special interest such as Tarwood, Rough Castle, and Carron Valley, and would eventually lead to larger recreational areas on the Shennanigan Plateau and in the Kilkenny Hills.

AGRICULTURE

In a sense it is unnecessary to make proposals for agriculture, since the Growth Area falls within the orbit of the Department of Agriculture and the West of Scotland College of Agriculture. The Survey and Plan, however, does provide a unique opportunity to integrate proposals for the numerous activities involved.

Proposals have been made in the section on Rehabilitation which could have far-reaching effects on the pattern of land use on the Slamannan Plateau, and on the poorer soils around Denny Muir. They include the use of processed town wastes, improved drainage, and the amalgamation of farms. It is also suggested that farmers might take advantage of the large quantities of spoil from building operations for utilising areas liable to flood, and badly drained hollows. Such a scheme calls for liaison between farmers and contractors, and the setting up of a co-ordinating Waste Disposal Authority.

It is also recommended that, after a detailed survey of the poorer soils and the preparation of comprehensive plans, afforestation should be encouraged on a large scale, not only to increase the productivity of these areas, but also to improve the local climate.

Executive development will result in increased recreational pressures on the countryside. A system of "greenways" or pedestrian footpaths has been proposed which would lead to lead and concentrate people in specific directions and areas. These proposals would need negotiations between Local Authorities, land owners and occupiers before implementation, and much will depend on the safeguards proposed to prevent damage and trespass. It may be necessary for the Local Authorities to introduce a part-time warden service, similar to the one run so successfully by the Peak National Park.

In the section on Recreation, recommendations have been made for the establishment of a "nature area" and a "model farm" in the Central Park, to incite town people into the richness of rural life. By this and similar means, it is hoped that public relations between town and country would improve.

## FORESTRY

These proposals have been based on the four main types of woodland found in the Area.

### Nature

It is proposed that the areas of existing natural woodland should be retained where possible, and that it should be encouraged to extend throughout the small areas of uncultivated land, derelict areas and steep slopes. This would enhance the quality of the landscape and help to redress the balance of woodland lost by felling, and the disappearance of hedgerows. The present distribution of these areas is shown on the Map No. 20, "Landscape Analysis."

### Anamly

It is proposed that in addition a planting programme should be carried out throughout the rural parts; along pedestrian routes; at picnic spots and car lay-bys, and where it is necessary to integrate alien objects like transformer stations into the rural scene.

The pattern of planting should be irregular and haphazard, using indigenous species, and showing none of the regularity associated with plantation planting. In addition, the programme of maintenance for such areas should aim at establishing an uneven age structure of woodland, by the felling of individual trees to make way for young ones, and assuring the continuation of a natural succession. Stirling County Council have already established a tree department, and should accept a responsibility for the enhancement and maintenance of the countryside.

It is also proposed that the extensive planting of trees be undertaken in the urban areas. These could have a substantial effect on the micro-climate in the more exposed settlements like California, Shielhill, Wallacetown, High Bonnybridge and Skinfair.

## Economic

It is proposed that the existing areas of dedicated woodland should be retained wherever possible, as they contribute both to the economy and the amenity.

It is also proposed that economic planting should constitute an important part of the land reclamations of the Slamannan Plateau. These proposals are dealt with in greater detail in the Rehabilitation proposals (Type 10).

The value of such woods will be significantly increased if they are planned from their conception as multi-use areas. They should make provision not only for the pedestrians, but also take into account the agricultural operations which involve animal movements, transportation and interfield communications.

By planting hardwoods and other ornamental trees, and designing fire breaks and planting blocks to add variety to the scene, their use as recreational areas will be considerably enhanced.

## Shelter

It is proposed that shelter planting should also constitute an important part of the reclamation of the upland parts. Here the emphasis should be on the maintenance of a relatively stable structure of vegetation, as opposed to the growing and felling of a crop. This proposal is also amplified in the section on Rehabilitation (Type 10).

It is also proposed that shelter planting be undertaken round the exposed settlements. These include those already mentioned in the proposals for amenity planting. Shelter planting should also be integrated with pedestrian routes and boundary planting round and through the proposed Environmental Areas, the Central Park, and in the Bo'ness recreational areas.

## RESIDENTIAL

A general description of the location of residential areas within the development pattern was given in Phase One: "Land Uses and Environment—Settlements". This section describes in greater detail the proposed residential areas, their standards of environment and their relationship to the new community facilities. Proposals are also made for the improvement of existing residential areas. Areas given are net: excluding schools and associated playing fields, local parks and local shopping centres, but including the simplest level of greenways and children's parks. Most of the population increase would be accommodated outside existing urban areas on undeveloped agricultural land, over half of it in districts around Falkirk. In areas of poor mining activities development may be restricted to some degree in layout, densities and methods of construction. Negotiations will be necessary between the National Coal Board and government authorities before development can take place in areas scheduled for future coal extraction north of Larbert/Stenhousemuir/Carronshore.

Urban renewal is proposed in designated CDDAs or CAs, and in a few areas where there is extensive poor environment and/or imminent obsolescence. The increased importance of the existing shopping centres retained as district level centres will stimulate building expansion and absorb some residential areas which are suitable for redevelopment. Urban renewal proposals are on the whole for areas outside the shopping centres, mainly in Falkirk and Bo'ness (a total of 105 acres). The overall density of all possible redevelopment areas was not high, so that it has been assumed that redevelopment areas could accommodate most of the displaced population. For

calculation purposes new residential areas have therefore been assumed to accommodate only the increase in population, except in Boness and Falkirk which have extensive areas requiring urban renewal and would accommodate some of the immigrant population as well.

Re-zoning for residential use has been proposed for industrial sites at Falkirk and Denny; and residential areas could also be re-zoned to industry at Grangemouth and Larbert. Implementation is likely to be long term.

## Environment

The design of housing areas should conform to the environmental structure laid down in the Research Studies related to the catchments of local shops and primary schools. Map No. 66, "Basic Residential Units", shows the distribution of Basic Units both for existing and proposed development. Design objectives for new housing development (see "Towards an Ideal Urban Environment") should ensure a satisfactory micro-environment, cohesive character, adequate distribution of community facilities, and an acceptable road framework.

The sites chosen for development are free from the harmful influences present in many existing areas (i.e. air pollution, poor micro-climate, poor outlook). The extent of development should allow areas to be planned comprehensively to lessen the effects of traffic volumes and noise. The high degree of pedestrian/vehicular separation envisaged should ensure safe circulation for both able-bodied persons and for the physically handicapped.

Housing should continue to be built by many agencies, i.e. local authorities, private developers and special agencies (SSHA, Housing Associations, etc.). The greatest proportion would be built by local authorities on a scale large enough to take advantage of industrialised methods. A certain amount of middle-income private development for sale or rent should be encouraged to meet the expected demand, but should be dispersed (see "A Policy for Middle Income Areas"). The range of house types should be related not only to variations in family structures, but also to the needs of the elderly and the disabled.

## Location of New Residential Areas

### Falkirk/Greenbank: proposed 470 acres (net)

Falkirk should continue as a major residential area, providing many houses close to the Regional Centre. The main new areas are at Greenbank; southwards to Glen Burn; within and south of Callendar Park. A portion of the northern part of Greenbank may reveal restrictions to development due to past mining activities (around Stanhope in particular). The Greenbank area will focus on a new district shopping centre.

Major milling should occur at Boness and Summerford, including a non-conforming industrial site proposed for re-zoning (most of these areas are already committed for housing). It is hoped that mixed land uses in the northern part of Falkirk may be rationalised where industry has an adverse effect on the environment (e.g. Hayfield). Some 75 acres are proposed for redevelopment at Callendar and adjacent to the Regional Centre (Howgate, Wallace Street and Ladymill).

Urban renewal should be at higher densities to exploit proximity to the Regional Centre, and similarly for residential areas immediately adjacent to Greenbank Centre. The areas south of Callendar Park (by Glen Village) would be attractive for private housing at lower densities because of difficult gradients and distance from the district centre.

Access to the Greenbank and Glen Village areas would be from the primary distributor road at Tenfield and East Callendar Wood, and also via slip roads at Glenburn and Summerford. Pedestrian greenway routes through this area would be linked to the regional network along the Union Canal to Callendar Park and Rough Castle.

### Grangemouth: proposed 80 acres (net)

Residential development should be restricted to the remaining committed residential sites at Bowhouse (to be completed by 1970), limited to the south by the M8, and to the east by the district distributor. A small proportion of this area should be for middle-income housing, at present scarce in Grangemouth. Further expansion of the population beyond 1970 should be accommodated on a regional basis, possibly at Polmont which has good road links with Grangemouth.

Redevelopment should be associated with the expanded district shopping centre at Lumsley Street (CDA), where further extensions are possible. Because of proximity to industrial areas and proposed major traffic routes, housing areas north of Boness Road and Dalmeny Road should be re-zoned for industry at the end of their useful life in the long term. Densities of new housing areas should generally be higher than the average because of the restricted area for development.

Access to the regional road network would be via Boness and Bellgait partial interchanges, or via the Boness Road primary distributor.

Expansion of the Burgh greenway routes from Zetland Park would give access to the proposed Newlands Golf Course, and thence to the main regional network south of the Burgh.

### Larbert/Stenhousemuir/Carronshore/Torwood /Glenboervie / Antonhill / Kincardine: proposed 560 acres (net)

Residential areas are proposed to form a major new urban complex north of Larbert/Stenhousemuir at Antonhill, Kincardine, Glenboervie, Torwood and north and east of Carronshore. Development at Antonhill would cover a large part of the former Tryt Golf Course. A few of the proposed areas are affected by past mining activities (to a lesser extent north of Stenhouse Castle but most severely around Carronshore). Little milling is proposed, except around Stenhouse Castle and in small pockets in south Larbert. New district shopping centres are proposed to serve this complex at Glenboervie and Carronshore.

Possible redevelopment areas adjacent to Main Street, Stenhousemuir, would probably be absorbed by the expanded district centre and road improvement proposals. A poor residential area at Larbert Cross should be re-zoned for industry.

This new urban complex should represent a complete cross-section of housing types. Glenboervie and Torwood are very attractive for high cost/low density/private development. Because of proximity to the district shopping centre and excellent orientation, Antonhill area would be expected to support higher densities than the average. Much lower densities would probably be necessary in the Carronshore area because of geological problems.

Road access to Larbert, Stenhousemuir, Carronshore and Kincardine would be from the primary distributor circuit route at a choice of junctions; and to Glenboervie and Torwood from the primary distributor at Torwood village. A very direct journey to work would be possible to Stirlingshire from all these areas.

5. Reserved for unchartered area

4. Residential development

3. Proposed residential areas

2. Existing residential areas

Map No. 85 Basic Residential Areas

Key 1. Basic areas



Major pedestrian routes would be linked to the part of the regional greenway system which circulates through Arnside and Cleator north to Torwood and south to the Central Park.

#### Denny and Duncrue/Dales Wood proposed 340 acres (net)

A large residential expansion is proposed towards Dales Wood, limited to the north by the crest of the hill, and to the east by high tension overhead electricity cables. A much smaller residential area is already committed at the western edge of Denny (Burgh expansion site) adjacent to the improved A88. Measures to overcome traffic noise will be needed at this area. In Dales Wood old mine workings and shafts should restrict development very little. When expanded, the existing town centre would serve as the district centre and would absorb poor housing areas adjacent to the central area (as committed CDA). In the long term a non-conforming industrial site north of the River Cullen should be re-zoned for high density housing because of its central location.

The Burgh expansion sites would accommodate slightly higher overall densities than the average for new housing. The northern area of Dales Wood should accommodate rather lower densities because of its distance from the Centre and its attractiveness for private development.

Road access would be mainly from the local distributor network and from the primary distributor via Headswood interchange on the improved A870, or at Bonnybridge, thus making possible a direct journey to work. Pedestrian routes in the urban area would connect to the regional greenway along the River Cullen and link with large recreational areas close by at Torwood and in the Kilsyth Hills.

#### Bo'ness proposed 270 acres (net)

New residential areas should be located mainly south of the town, stretching from Kinnel to Muirhouses and limited by steeper north-facing slopes, and water supply problems. Extensive shallow coal outcrops and old shafts present problems for development which increase with severity towards the east, but development may only be restricted on a small proportion of land.

Major infilling would be limited to a derelict site west of Caudlekin. The new shopping centres re-located in Douglas Park would also serve the new development. Only a small part of the old shopping area immediately north of the Town Hall (all of which is committed as a CDA) should be re-developed for housing, the remainder being re-zoned to extend the proposed Marine Centre on the foreshore and to round off existing industrial area. The main area of residential redevelopment is proposed east and south of the existing Grangemouth housing scheme, and plans are in hand for a small part of this. Urban renewal areas total 30 acres.

Sites at Kinnel and Borrowstoun Manse are already committed for housing development and lower densities than the average would be expected on the former site. Higher densities would be expected on sites adjacent to the school complex because of proximity to the district centre. Geological conditions may cause lower densities towards Muirhouses and Drum.

Access to new areas would be from the district distributor loop road which joins the primary network at Kinnel Colliery.

Internal pedestrian greenways would link the housing areas and the proposed Marine Centre to the main regional network, skirting housing to the south and along the Antonine Wall.

#### Lawerton/Bughton area proposed 170 acres (net)

Major residential expansion would be mainly in the Polnoon and Salmon Inn areas infilling and rounding off only as proposed at Lawerton and Bughton. Limited housing redevelopment should be possible in the committed CAs at Lawerton, where the shopping centre would be renewed, and also in pockets along the main streets of Lawerton and Bughton. Geological problems are known to exist in Redding and Brightons, and will probably restrict development in the latter area. There would be no major shopping centre. In keeping with the "rural" character of the district, densities should be on the low side, because of geological conditions and because many attractive areas could be developed for middle-income housing.

Road access would be mainly from the primary network at Polnoon Station. A local road link would be required to allow convenient journeys from Polnoon to the Grangemouth industrial area. Part of the regional pedestrian greenway system runs along the Union Canal through the residential areas and would link Grangemouth via Westquarter Burn.

#### Outlying Settlements proposed 75 acres (net)

Little residential expansion is proposed except in Sheldhill and Bonnybridge, where development is already committed. Old coal workings may be found in parts of Bonnybridge, but should be unlikely to affect development to any extent. Extensive tree planting should help to protect settlements located at high altitudes from their present severe micro-climate conditions. It is proposed that scattered residential developments at Redding Muirhead and Wallacetown should not be renewed at the end of their useful life since their small size, poor environmental conditions and distance from adequate community facilities make further growth undesirable. Longcroft, with dwellings mostly in poor condition, is very scattered and would be affected by the primary road network serving Bonnybridge industrial area, and should be gradually phased out. Skirlaw village is more self-contained, but in the long term would be surrounded by large industrial estates. If environmental conditions become too unsatisfactory, residential development should not be replaced.

Access in the main would be from existing minor roads, except at Bonnybridge, where the industrial area would have links to the primary and district distributor networks.

Bonnybridge, Birkock and Haig's would have direct pedestrian greenway links to the main sites of Roman remains. Most of the village at higher altitudes would be situated in areas of regional-scale recreation, and links with the regional greenways would mainly follow watercourses.

#### Urban Densities and Population Distribution

An average net density for new residential areas of 50 ppa was agreed at, derived from the "Intensity of Development" study. In application, variations would be acceptable within this average where occasioned by topographical, material or policy decisions. Where extreme, these variations have been indicated above. However, as many physical problems are likely to be encountered in the siting of residential areas (see "Growth Potential, First and Second Stages") that a slightly lower density was found to be more practicable (approximately 45 ppa). The net densities of new urban areas and the population distribution is shown in Table 1.

TABLE 1 *Urban Densities and Population Distribution 1986 (excluding Outlying Settlements)*

Urban Area	Population 1986	No. of new Basic Units	Net density of new residential areas	Average new residential areas
Falkirk/Gourock/Glen Village	63,250	15+	54.5	430
Grangemouth	25,900	3	58.3	92
Larbert/Stenhousemuir/Torwood/Glenboe/Glenrothes/Cairnhill	54,750	20+	40	960
Denny and Dunipace/Dalkeith Wood	22,750	8	43	340
Bo'ness/Kincardine/Muirhouses	23,000	6+	36	270
Laington/Brighton	16,500	5+	30.5	170
TOTALS	206,150	56+	43.5 average	2,300

### Revitalisation of Existing Residential Environment

The areas defined in the "Environmental Assessment" as having deficiencies and subsequently assessed in the Research Studies for their improvement possibilities, were classified into three categories. Areas in the first category indicating suitability for redevelopment have been mentioned in the section on proposed areas for residential development. Those in the second and third categories, suitable for either long or short term improvement, provide the basis for improving the existing environment.

### Proposed Areas for Revitalisation

In all parts there are pockets of residential development suitable for revitalisation: improvements may be short or long term, depending on the estimated life of the dwelling and ease of implementation, and will therefore be the subject of local decision. Action taken for improvement should relate to certain environmental principles which have been listed in the Research Studies, including rationalisation of traffic circulation and land uses, provision of further car parking spaces, children's and community facilities, and improvement in pedestrian safety and visual appearance. The largest areas suitable for improvement are in Bo'ness at Castleloan; in Grangemouth adjacent to the town centre and north of Bo'ness Road; and in Falkirk at Mongelaw, Grahameston and Cairnmuir. Much smaller pockets occur in all other urban areas usually associated with districts suitable for redevelopment, with concentrations in Stenhousemuir and Redding/Pelmont.

Areas downgraded because of proximity to main traffic routes, which cannot therefore be improved at present, occur in small pockets, but most frequently in Larbert/Stenhousemuir, Bo'ness, and Grangemouth, where many main traffic routes traverse otherwise adequate areas of residential environment. By the time new road proposals are able to relieve these areas of their traffic nuisance, economic provision for the measures needed to upgrade these areas may be in force.

An example of areas suitable for revitalisation is shown on Map No. 67—"Revitalisation of Existing Environment—Grangemouth".

The procedure for revitalising local authority residential areas would be simple, and it may be possible to incorporate property improvements into such schemes. It is important to obtain the help and understanding of residents and publicity should be used to promote such aspects as rationalisation of traffic circulation and resulting traffic restrictions, repainting and maintenance schemes and the importance of the protection of pedestrians and children from all hazards. If voluntary co-operation is not forthcoming in cases of privately owned

property, the purchasing of key sites or dwellings may be the solution: as is being done by Newcastle Corporation under the recently approved Rye Hill Revitalisation Scheme.

Revitalisation schemes could be aided by the following means:

By demolition of selected houses to obtain extra space for additional essential facilities (e.g. parking spaces, play areas, shopping and community facilities);

By environmental management schemes to rationalise traffic circulation;

By designation of revitalisation Action Areas in order of priority within the long term plan;

By ensuring that all action is taken comprehensively and not piecemeal.

Where areas have been defined as being "along an existing main traffic route but possibly suitable for improvement later", in severe cases the owner or occupier should perhaps receive financial assistance towards altering the property (i.e. double-glazing to reduce noise) on the same lines as compensation for noise is made to householders living adjacent to airports. This would obviously be subject to the structural soundness and life-span of the dwelling.

### COMMUNITY FACILITIES

Where large expansions of population are proposed, provision of adequate community facilities is as important as that of homes and jobs. Not only should the range of facilities provided be comprehensive to suit the demands of the urban population at all levels, but their location should also be convenient. This will matter most to the home-bound mother, her children, the elderly and the disabled.

Coupled with easy access, these facilities should be made attractive to visit in their urban location by the form of layout, design of buildings and the safety and ease of movement in public areas.

This section deals with the proposed provision of community facilities. Their optimum relationship in the urban structure and design objectives have been fully explained in the foregoing section, Research Studies: "Towards an Ideal Urban Environment".

### Shopping

The Research Studies showed how an hierarchical shopping structure should be built up in order to achieve an even catchment population distribution, and an adequate range of facilities at each level. The specific requirements for shopping floor space, and the retail turnover for each centre have been outlined in Volume One, Chapter 5. The design of new or expanded centres should provide for pedestrian separation, convenient and attractive surroundings

for shoppers, special facilities for the disabled and separate service vehicle access. The growing use of the car should be planned for in district centres, but it is expected that for shopping in the regional centre, the restricted accessibility and the delivery services available would encourage the use of public transport. Parking needs are mentioned in Volume One, Chapter 5.

#### Shopping Catchments

The proposed residential distribution would support some 50 to 60 local shopping centres. Eight district shopping centres would be needed, of which three would be completely new (Glenbervie, Carronshore and Greenbank), the others would be expanded. Falkirk would continue as the major centre with regional scale facilities. Though the centre would continue to grow, it should still be focused on the High Street which should be preserved for its attractive townscape. The High Street, which should be freed of traffic, would act as a district centre for its immediate residential areas, and likewise all district centres would act as local centres for the adjacent populations. (A detailed study of the location of expanded facilities and the proposed circulation patterns for both cars and pedestrians in Falkirk Central Area is shown later in "Process of Application".)

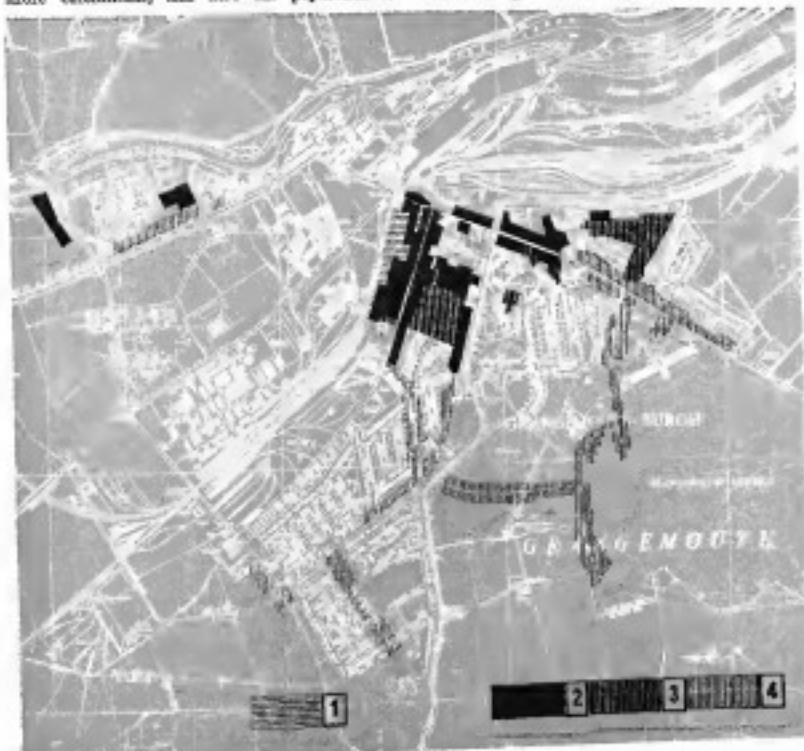
Application of the shopping hierarchy reveals certain cases where the district centre catchments could not be easily resolved. There is unavoidable overlapping between the Stenhousemuir/Carronshore catchments, and here the population is

assumed to choose equally between the two centres. However, where the Greenbank/Camerdon catchments overlap, the nature of the steep terrain would probably prompt residents at Summerford to use facilities in Camerton.

In Grangemouth, the location of the existing main shopping centre at Lumley Street is eccentric to residential development and poses problems of distance and convenience, especially for the new housing areas. Because committed redevelopment proposals would expand the shopping facilities to "district" importance in the hierarchy, and there is no suitable alternative site, it is proposed that Lumley Street should continue as the major centre for Grangemouth. However, the new Charlton Dundas Centre offers a reasonable range of facilities for the south-east part of the Burgh and is in fact of expanded local centre size. Falkirk Centre would also be convenient from here (see Volume One, Chapter 5).

The Linlithgow/Brightons area also poses problems of distance and convenience, due to the scattered nature of the residential areas and proximity to Falkirk, so that a district centre would not be the best solution. Committed plans for redevelopment of the existing Linlithgow centre would provide a larger size local centre, whilst Falkirk would be visited for district level facilities. An expanded local centre is also proposed in the Polmont House area to serve Brightons and Polmont, but this fringe population would be most likely to visit Grangemouth (Lumley Street) for district level facilities.

The existing centre at Camdon, strung out along a



Map No. 67: Revitalisation of Existing Environment—Grangemouth

Key: 1. CDA—Comprehensive Development Area. 2. Probable redevelopment area. 3. Suitable for long or short term improvement. 4. Environment affected by existing main traffic route, possibly suitable for improvement later.



Map No. 62: Southampton

Key: 1. Primary authority boundaries 2. Lesser local authorities 3. Local shapes 4. Catchment areas 5. Regional centre 6. District centres 7. Local centre 8. Direct connector roads 9. Minor roads

Table 2 Shopping Centres: Size and Location 1986

Growth Area Centre	District Centre	Larger Local Centre
Falkirk (125)	Falkirk (16) Gougenouth (Lindley St.) (16) Stonhousemuir (10)	Polkemmet (8) Lochwinnoch (4) Gougenouth (Charlton Dundas) (7)
	Glenboerie (18) Carronshore (10) Denny (13) Greenbank (12) Bo'ness (34+) Camelon (9+)	

busy road, should be relocated in a more convenient and central position near Lock Street. The compact distribution of residential areas and possibilities for urban renewal at high densities would provide the catchment population for a district centre, in spite of proximity to Falkirk Centre. Population within the overlap of these catchments would be expected to choose between Falkirk and Camelon according to distance.

Among the few residential areas which would lie outside any district centre catchment are those of Torwood and the northern parts of Dales Wood (Denny). Both these areas have been proposed for high cost/private development, and it is expected that residents would make most shopping trips by car.

#### Location of Centres

Table 2 above shows the hierarchy and location of major shopping centres proposed and the population catchments (by Basic Units). In addition, local shopping centres would serve every Catchment Unit (2-3 Basic Units) of residential areas. The detailed distribution of centres with their catchment areas can be seen on Map No. 68—"Shopping".

It is expected that residents of outlying villages would continue to support the limited facilities available to them for day to day needs, but that for a wider range of goods they would be attracted (if not directly to Falkirk) to the following centres: Shielhill and California to Greenbank; Airth and Dunmore to Carronshore; part of Bonnybridge, Stonywood and Fankerton to Denny; Banknock, Hagg and Lariston to Falkirk; Polmont to Grangemouth; part of Bonnybridge to Camelon.

#### Existing Centres

Strict development control should be applied to existing shopping centres, in order to achieve the desired hierarchy. Where large scale expansion of district centres is proposed, traffic-free precincts should be created as soon as possible with car parking facilities, stopping places for buses and rear service access.

Where small existing centres are not in convenient locations for their population catchments, no prospectus for expansion or retention have been made. These centres should not be allowed to inhibit the realisation of a more modern shopping pattern and should be phased out eventually. Operations to eliminate the struggles of weak and inefficient shops (i.e. parts of Camelon and Gougenouth) should begin as soon as possible, and these areas should be controlled to prevent redevelopment or reconditioning of existing premises. Most of the retained local centres have possibilities for long term improvements by means of a rationalisation of the road pattern, planting, provision of parking facilities; and restriction of servicing at the front during shopping hours.

The popularity of the new Charlton Dundas Centre in Gougenouth, and to a growing extent Callander Riggs, Falkirk, has proved that a high quality of design and attractive facilities in shopping centres makes an immediate impact. These schemes should give a lead in the standards expected both for expansion of existing and for new shopping centres.

#### Education

The Research Studies indicated how educational facilities could be related to the community structure. In particular their location should ensure a reasonable walking distance, with a maximum of three-eighths of a mile, along safe pedestrian routes for primary school children; and all Roman Catholic and secondary schools should be accessible by bus. Primary schools in many cases could be located near local shopping centres so that mothers can make multi-purpose journeys.

Some movement of children and young people out of the Area would continue for further educational needs (i.e., University) and because there are no direct grant or independent schools. Nevertheless, as the population increases, the range of further education courses, adult evening classes, day release classes, etc., should be able to be expanded to meet the expected demand, since existing centres for these facilities are modern and well-equipped.

Primary school facilities should be centralised wherever possible so that new schools can be two-stream in size. Many existing schools will need to be reconstructed or replaced soon because of their extreme age, and this will create opportunities to improve the present distribution of schools in relation to catchment populations. Many of the smaller schools could be expanded to advantage.

The general trend towards comprehensive secondary education and the economic advantages to be gained thereby suggest that the minimum size of secondary schools should be 1,000 pupils. Present commitments for school expansion in Larbert, Falkirk and Bo'ness will help to achieve this, but most other schools will have to be adapted to meet changing requirements.

Since it is proposed that more employment should be available for married women in particular, some attempt should be made to meet the rising demand for nursery school classes, possibly attached to primary schools.

No detailed proposals have been made for Roman Catholic schools, and a proportion of the new schools will have to be allocated in accordance with the demand.

#### Future Provision

The total school population was projected to give a gross estimate of 54,200 primary pupils and 19,600 secondary pupils by 1986 (See Volume One, Chapter 8).

The number of additional school places required between 1964-86 would therefore be 16,370 primary and 11,890 secondary places. Including new schools already committed, some thirty new primary schools and nine new secondary schools would be required to serve the expanded population. Their location should be closely related to the proposed pattern of residential distribution as follows:

TABLE 3  
Distribution of New Schools

Residential Areas	Primary Schools	Secondary Schools
FALKIRK		
Greenside	2	2
Caledon Park	1	—
Grahamston	1	—
GRANGEMOUNT		
Bowlhouse	2	1
LARBERT/STENHOUSEMUIR		
Ainschill/Stenhouse	2	2
South Braehead	1	—
Kinnaird/Torwood/Glenbervie	5	1
Carronshore	2	—
DENNY AND DUNIPACE		
Dales Wood	3	1
Birch extension area	1	—
BO'NESS		
Kincraig/Muirhouses	4	1
LAWERDON/SHOOTERSHILL		
Polsmuir area	1	1
TOTALS	30	9

### Health and Welfare Services

The proposals for reorganising Health and Welfare Services to cope with the expanded population are discussed in Volume One, Chapter 8. The major recommendation is to establish an Area Health Board and a Social Work Department to jointly administer a comprehensive service for all health and welfare needs (including hospital facilities).

These administrative reorganisations would result in some demand for extra space, though present expansion commitments, coupled with the development of other health services described below, do not suggest that large areas would be required for hospital building. Most hospitals could in fact extend within their own grounds, and future deficiencies are more likely to be met by better equipment and more staff than by increasing the number of beds. However, to safeguard its amenities it is proposed that the hospital zone north of Larbert should be extended eastwards and westwards within the confines of the major road networks.

The shortage of general medical and dental practitioners is likely to continue for some years, and additional practitioners required for the expanded population should be encouraged to come to the Area. Health Centres (see Volume One, Chapter 8) should be set up, which offer medical staff excellent, well-organised working conditions.

These Centres would contain general dental, medical and local authority health services (including maternity and child welfare clinics) in one building complex, and could be most successfully established at district shopping centres in new development areas where the catchment population is concentrated within a short distance of the centres, i.e. at Bo'ness, Denny and Dunipace, Glenbervie-Kinnaird and Carronshore. In Falkirk, where the general medical practitioner framework is well-established, it would be advantageous to expand group practice in conjunction with a Family Doctor Diagnostic Centre providing that administrative and financial difficulties could be overcome (see Volume One, Chapter 8).

### Social Facilities

The expansion of facilities for entertainment, recreation and community life should provide the means of integrating existing and new communities. As these should be made easily accessible to large numbers of people travelling by public transport and car, they should be concentrated as far as possible in district shopping centres, whose planning should be flexible enough to cater for unpredictable trends in demand.

Nearby commercial entertainment centres like Edinburgh and Glasgow would be able to satisfy specialised demands, but by 1986 the Area should support many general and some specialised commercial entertainment facilities. Provision would largely depend on private enterprise and demand is somewhat unpredictable, but cinemas, commercial theatres, dance, bingo and billiard halls, commercial sports facilities, bowling alleys, roller-skating rinks and dry-ski slopes would be needed. Parking facilities could be shared if these facilities are accommodated in the district shopping centre.

Facilities with a more predictable demand are also proposed for each new district shopping centre: cafes/restaurants, hotels, several public houses, and at least one theatre or a building suitable for amateur productions (see also below). In addition, cafes and public houses should be sited within the residential areas according to their social characteristics, but generally in a ratio of one each per local shopping catchment.

Non-commercial social organisations should continue to thrive and though the range of activities may change by 1986 their accommodation should remain similar. It was proposed in Volume One, Chapter 9, that a Central Committee should administer and finance these facilities, to ensure an adequate range of distribution, and the intensive use of accommodation. A variety of accommodation would be required for hire, and a number of sites would be needed by organisations desiring to build their own premises. School classrooms should also be used outside school hours, and in such cases it may be feasible to incorporate clubrooms in new schools. Small public halls and rooms should be available for hire within residential areas, and privately owned clubrooms and churches would need sites.

More specialised organisations should be located at the new district centres within Community Centres, thus creating a focal point for social life in each district. These Community Centres should incorporate rooms and large halls for hire, a theatre or stage, perhaps a gymnasium and/or swimming pool and a branch library, in addition to the usual cloakroom and kitchen facilities. In most urban areas existing facilities would also need to be improved and/or expanded.

Physical recreation, closely connected with open space, would largely be catered for within parks and play areas. The attractiveness, distribution and quality of these facilities would be more important than their acreage. This is dealt with in detail in the proposals for recreation.

### INDUSTRY

Following from the general distribution of urban functions described in the Chapter on Settlements, this section presents more detailed proposals for the siting of manufacturing industry and such service industries as are suitable for location in main industrial zones. Industry is a vital land-use and a key factor in the further development of the Area, so that the widest possible range of locational possibilities have been proposed. It is hoped that the

Local Authorities will use the proposals as the basis for action in a vigorous campaign to attract new industry, without which successful development cannot take place. That such a campaign is essential cannot be too strongly stressed.

### Needs

Estimation of land needs was based on calculations of the total population employed in manufacturing industry (see Volume One, Chapter 4). The general density ratio of workers to site area on new industrial sites was assumed to be about ten workers per acre. This figure, although low, was purposely used to allow a measure of flexibility in the proposed physical structure. The density ratio may be higher in the course of implementation but equally it may not be necessary to develop all the sites indicated in the Plan by 1985 to meet the target employment figures. A wide choice would then be possible of several proposed industrial sites which will both help to attract industrial developers, and make it easier for Local Authorities to meet their various requirements. The only exception to the applied standards has been made for a new industrial site round Grangemouth, covering a large area already designated for industry. This has been acquired by petrochemical firms, and only capital intensive industries are expected. This type of industry always supports a very low worker density so a figure of five workers/acre was adopted for 75 per cent of all new land designated for new industry on this 455-acre site.

Estimation of land needs for new industry is as follows:

check on the proposed industrial locations. All these investigations showed that potential industrial sites round Grangemouth would appear eminently attractive to large petro-chemical type industries with low employment requirements which make stronger demands on capital and land than on labour. Moreover, they are mainly already set-marked by existing concern. With a few exceptions (i.e. Skinfold and part of Bonnybridge), all other land was found more suitable for small industries. It would seem logical to allow further subsidiaries of the petro-chemical industries round the Grangemouth sites; even though this is a factor which will severely curtail residential growth and will necessitate precautionary measures against any noxious gases produced by these industries. In the remainder of the Area, however, it is recommended that only non-noxious industry (with higher employment densities) be encouraged. Both the economic and physical analyses indicated the feasibility and desirability of amalgamating a number of new sites into a second large industrial area around Bonnybridge.

The remaining sites should be dispersed, forming a limited number of smaller industrial groups closely linked to residential units. This is to allow local employment opportunities especially for those unable or unwilling to travel far to work (e.g. married women), to round off existing areas, and eventually permit the growth of industries closely associated with commercial centres.

A large, flat area north of the River Carron is a potential site for large-scale land users (Skinfold). This land has not been included in the development

TABLE 1 Estimation of Land Needs for New Industry

	Employment			Land acres (10 workers p.a. and 5 workers p.a. in Grangemouth)
	Housing	1985	Net increase	
Grangemouth	...	8,000	11,940	3,930
Falkirk Area	...	10,575	11,475	900
Larbert Area	...	2,871	2,341	23
Denny Area	...	1,180	2,575	1,265
Bonnybridge Area	...	3,273	8,315	5,940
Pulnong, Larbert, Brightons, etc.	...	597	822	225
Bo'ness	...	829	1,549	720
<b>TOTAL</b>	...			1,460

The most important figure is the overall total of 1,460 acres required to meet employment needs. Some alterations in the numbers of workers employed on existing sites will of course occur as industries change their operational techniques. Therefore, this Table can provide only the broadest appreciation of land needs. The figures relating to the respective settlements are also only indicative, since the main principle of industrial distribution was based on concentration of the majority of the new industries on a limited number of sites rather than dispersal.

### Character and General Distribution

It is difficult to predict with accuracy the character of future industrial development. However, some pointers can be obtained from the results of the survey, the physical analysis and the economic studies. In addition the impact of implementation of the recommended road system on suitability of land for industry was analysed (see Map No. 60) as a further

proposal, but should be reserved for specific types of industries. The character of Skinfold has been discussed in the analysis of industrial location (see "Growth Potential Plus Site: Industry") and in Volume One. The proposed location of industrial land is shown on Map No. 76—"Structure Plan 1980".

Mining is an important factor influencing the availability of land, and investigations will be necessary in all areas before development, because of lack of detailed information on present and past mining activities. Indications are given here in this Chapter on the problems which may be encountered on specific sites. More detailed information is found in the Chapter "Mining and Subsidence".

### Location of New Industrial Areas

The Chapter on Settlements showed the relationship of major industrial sites to other land uses. This section gives more details of individual sites.



**Map No. 69: Industry—Classification of land for location of industry after implementation of recommended road system**  
**Key:** Classification before road system is implemented (ref. to Map No. 36): 1. Class A. 2. Class B.  
 3. Class C. 4. Class D. 5. Class E. Possible influence of implemented road system: 6. Degree of suitability increased. 7. Degree of suitability decreased.

**Grangemouth:** proposed new development 610 acres (east from the M9) and 235 acres (west from the M9 and east from the primary distributor)

Grangemouth would continue to be a regional employment centre. Existing areas along the foreshore and A904 would be extended to the limit of the Whittlesea district distributor road to the south, and to East Kincraig Marine in the east. Access would be possible direct via Larbertian Inter-change with M9 or via Skinfold or Abbercraugh to the main road network. A green "buffer" zone would separate these areas from the adjoining residential districts to safeguard their environment.

The main new areas of industrial development at Middlefield and West Main would be centrally located between Grangemouth and Falkirk. This extensive site adjoins existing timber-yards. Development would be possible immediately, but should not be noxious in character because of the prevailing winds across Grangemouth. No mineral problems are to be expected in these areas. There may be problems concerning the load bearing capacity of the sub-soil.

A further area is already proposed in South Skinfold, but a pedestrian greenway should be safeguarded along the River Carron to link with the regional network at Glenboig. A much larger area at Skinfold should be reserved for large scale development only, and may therefore be a long term proposal.

#### **Falkirk: proposed 145 acres**

Falkirk suffers from a haphazard mixture of land uses, and some rationalisation is needed as follows:

The goods yard at Falkirk Grahamston Station should be phased out in order that it may be used as a car parking area. Goods activities should be re-located to Ladysmell Goods Depot, but it is hoped that this area can be more intensively used than at present, so that at least part could be re-zoned for residential use in the long term, providing the nuisance created by the adjacent concrete works can be eliminated. Heavy industrial processes on sites adjoining the Falkirk central areas (e.g. Merchiston (part) and Ladysmell areas) are considered to be non-conforming.

It is hoped that the brewery within the central area could be replaced by commercial uses in the long term.

It is proposed in the long term to reduce or prevent industrial development north of the railway line skirting the central park, because of this area's recreational potential and amenity value.

Most industrial works should be phased out at Summerford and Lime Road, and the area re-zoned for housing and public open space. The Tar Distillers Co. at Lime Road, however, may continue to affect adjacent housing areas as it is one of the most serious sources of nuisance. Careful consideration should be given to the measures which could be taken to alleviate this nuisance. Slight expansion of Burntford industrial area outward is envisaged.

Proposals for industrial development at Lechlands have already been made, but this site should not be expanded further because of the need to safeguard a greenway between the Central Park and open space leading to Tar Wood, and because any further generation of industrial traffic would make satisfactory

access to the primary network difficult. This site would practically complete the encirclement of the central park with built-up areas.

#### *Larbert: proposed 25 acres*

Little extra industrial development is envisaged here since manufacturing employment would be provided elsewhere on a regional scale.

The existing industrial site at Larbert Cross (between the railway line and the A9 where the present poor housing area will be re-zoned) it is proposed to extend by redevelopment southwards to the river. A physical break exists already between the residential development due to the railway on one side, and the A9, a primary distributor, on the other.

Another large existing industrial site at Carron has long been in existence, and extends southwards into Bainsford, Falkirk. It is hoped that both adverse visual and environmental effects would be lessened or removed in the long term.

Small non-conforming industries in the residential areas should be re-sited if possible.

#### *Pelmont/Laurieston/Brightons area: proposed 5 acres*

Very little industrial development is envisaged in this area (except service employment) because of the few suitable available sites and the predominantly residential character desired.

Brickworks and gasworks at Redding are near the end of their useful life and sites should not be re-developed by these industries because of their noxious character.

A service site (or light manufacturing industry) is proposed at Old Redding Road, Laurieston, since the site has separate access and is unsuitable for housing. The existing explosives works is to be redeveloped and negotiations are understood to be proceeding for location of a new industry on the old ICI works site at Redding Muirhead. However, site conditions may not permit previous leadings on redevelopment.

#### *Bo'ness: proposed 65 acres*

Industry would be confined mainly to the foreshore except in the harbour area. Here, existing derelict industrial areas should be improved and existing scattered developments linked. Kincard Colliery would be the limit of the industrial zone at the west end, but after 1986 industrial development may be desirable seawards when the present tipping area is filled and mudflats are reclaimed to give larger sites. The site immediately north of Grangemouth housing should be reserved for innocuous industry only.

Part of the old town centre should be re-zoned for industry. Access to sites along the foreshore would be available from old Grangemouth Road, where it is re-aligned.

One other small area is proposed at Borrowstoun and should accommodate only service or light innocuous industries. Special foundations may be needed here because of possible subsidence produced by movement of lower strata. This site provides an alternative location immediately available to industrialists and could help to achieve more diverse journey-to-work flows. Access to A706 and A904 southwards is necessary. Overwhelming geological problems in the vicinity of the industrial site formerly proposed at Muirhouses resulted in its rejection.

#### *Denny: proposed 65 acres*

Industrial land should be limited seawards by the disused railway line and taken the form of infilling around existing areas adjacent to the River Carron. Expansion should take place mainly southwards around Mylne and the existing metal works, limited by the district distributor. Part would be held in reserve for later expansion. There are some old coal workings in this area, but only at a considerable depth.

#### *Bonnybridge: proposed 250 acres*

Bonnybridge is proposed as the second major concentration of industry and will provide alternative sites for industries attracted to the Cumbernauld area.

The sites would be smaller than in Grangemouth, catering mainly for light industry because of meteorological conditions which are fully described in the chapter "Climate". Nearly all new sites need rehabilitation (which would be undertaken in conjunction with the refuse disposal scheme), to improve sub-soil conditions before they can be made available for building. Old workings and pits in the eastern part of the area will probably restrict development, as may the nature of surface deposits.

A greenway should be reserved south of the main industrial sites along the Canal and the Bonny Water, linking Castle Cary and Rough Castle.

The main access to the estate is proposed from the district distributor road running parallel to the Canal and to the primary distributor going through Longcroft, where existing scattered housing should be gradually phased out.

In High Bonnybridge mixed land uses should be rationalised as far as possible, because noxious industries widely affect the residential areas.

#### **Problems of Renewal**

Industrial renewal is a complex problem and detailed proposals require comprehensive studies of the particular site involved. Nevertheless, some general principles should be mentioned in connection with the overall urbanisation policies.

Industrial renewal or redevelopment is governed by several factors: the physical conditions of the factory itself, its influence on the surroundings, the economics of the industrial group and of the individual firm. If an industry adversely affects adjacent residential areas and is also technically sub-standard, consideration should be given to its relocation on another site which lies at a remote distance from any residential area. However, if a substantial non-conforming industry is in satisfactory premises and its relocation therefore unjustifiable, its noxious influence should be minimised as far as possible by the use of grit screening equipment, micro control over smoke emissions, sound deadeners, sound absorbent materials, planting, etc. (more detailed information is contained in the Phase One Chapter "Settlements: Air Pollution", and in Appendix No. 4, which gives a list of noxious industries and zones of influence). Where noxious industry is technically sub-standard, opportunities for redevelopment may occur.

#### **Planning Policies**

Flexibility is a key element in planning for industry. As mentioned above, low design densities were chosen purposely to aid this. It was also obvious that many of the existing industries are underutilising their land; thus, they often have a

substantial area suitable for expansion or modernisation without exceeding their sites.

Finally, it must be stressed that the new industrial centres must improve upon the nineteenth century image which many areas present today, to create a high standard of design and layout that will be attractive to new industrialist and employee alike.

## MINING AND SUBSIDENCE

In areas which are proposed for development, detailed investigations would be needed if they are not already cleared by the National Coal Board.

In a few special cases some of the proposed development is on land affected by past mining operations and special investigations (including site surveys by bore and probe) would be needed to prove them suitable. In other areas development is proposed on land under which the N.C.B. may extract coal at some future date. In such cases, consultation would be necessary with the N.C.B. to ascertain probable subsidence and to determine such structural safeguards as may be necessary. Negotiations may also become necessary to agree any possible compensation due to the N.C.B. for possible sterilisation of mining operations.

## RECREATION

Recreational has become a highly organised part of the way of life, and its quality and success depend on the available choice of facilities and the manner in which they are managed. To help make these choices, and to investigate and co-ordinate the recreational resources, departments, organisations and activities throughout the Growth Area, it is suggested that a special administration be set up. This would not supersede the established departments (including those dealing with parks and education) which are at present responsible for the open space requirements, but would make a continuous social evaluation of leisure activities and facilities, and would make recommendations for their extension, modification or termination.

The distribution of recreational facilities is shown on Map No. 74, "Structure Plan 1960".

### Parks

It is suggested that park provision be based on the standards already detailed in the preceding Research Studies. These were based on a comparable region, the Lothians, and the approximate adjustments have been made to coincide with the Environmental Areas of the current study.

### Regional Parks

Four areas have an outstanding potential for regional and inter-regional use. They set the areas between Falkirk and Stenhousemuir (about 300 to 400 acres); between Bo'ness Dock and Grangemouth (50 to 60 acres); Callendar Park (100 to 150 acres); and Rough Castle (between 100 and 200 acres). Facilities available in these parks are described below:

#### Callendar Park

It is proposed that a large regional park be developed in the central open space between Falkirk and Stenhousemuir. This park should provide facilities which need a large population to support them, and might include:-

1: a traffic playground in which the rudiments of the highway code are taught and practised. Bicycles,

pedal cars and tricycles could be available for hire, and rations could be programmed to extend from young children to the teen-age scooter and motor-cycle owners.

- 2: a children's area and model farm in which the rudiments of farming, countryside appreciation and animal care are shown by providing a simple display of different crops and their utilisation, and domestic animals (rabbits, hens, ducks, geese, donkeys, pigs, bears, etc.).
- 3: a nature trail in which a series of different natural environments are created, providing a variety of soil conditions; each type of area would have its own flora and fauna, documented for sectional appreciation and signposted for identification.
- 4: It is also proposed that, subject to a favourable hydrological survey, a large lake should be created. Coupled with straightening the River Carron, this would help to alleviate problems of flooding downstream.
- 5: It is proposed that some recognition be given to the historical background: industrial archaeology needs a focus to which the adherents can carry plant and machinery of historic interest, which might otherwise be destroyed. The Growth Area was in the forefront of the Industrial Revolution, and great names like Watt, Carnegie and Cadell have been associated with it. An area such as the Central Park, adjacent to the Carron Iron Works, should be fitting for such an enterprise. This relatively large area may also be considered suitable for several of the Local Parks which could be situated round its perimeter.

These suggestions illustrate the need for a system of integration between schools and recreation facilities. Only from such a liaison, and active support, can the necessary feed-back be obtained in making improvements.

The farm and nature trail type of feature would also help to create some sense of confidence in farmers and landowners, who will be increasingly subjected to the pressures of the urban community in the countryside. It may also put them in a more amenable frame of mind to accept access agreements, if they realise that the towns are accepting greater responsibility beyond theirburgh boundaries. By such a system the countryside may become more intelligible to and appreciated more by an increasingly urbanised society.

#### Bo'ness

It is proposed that a regional marine centre be established at Bo'ness Docks. Since so many boats are now drawn in rather behind cars, special provision should be made for convenient parking and unloading. Ramps may be necessary to take boats and trailers to the water's edge at low tide.

In view of the increasing interest in water sports, the harbour seems ideally situated to serve enthusiasts from as far as Edinburgh, and certainly from the new complex developing round Livingston.

This site should also be considered for the first Bo'ness District Park.

#### Callendar Park

Callendar Park is one of the few examples of an area of mature amenity landscape devoted to public use, and had it been situated between Falkirk and Stenhousemuir it would have served a much larger population. Considering its position, character and recent residential development, one of Falkirk's District Parks should be sited here.

The heritage abandoned by the Romans is now part of European culture, and an important feature of the Growth Area. The Antonine Wall, military way and forts not only provide a spatial link from the Forth to the Clyde, but also a temporal one between two civilisations. The Ministry of Works have plans to develop this section of the Wall for display, and the nature of the surrounding terrain makes it suitable for certain recreational uses.

That concludes the main proposals concerning areas to which people go. The following proposals concern areas through which people go. There is a further fundamental distinction between these areas: the first are owned and managed by local and public administrations, the latter are privately owned.

### Linear Walkway System

It is proposed that a linear walkway system be established throughout the Growth Area taking advantage of natural features, existing rights of way, and other linear elements in the landscape. These elements include: the Union Canal, from Falkirk to Edinburgh; the Forth and Clyde Canal, from near Grangemouth to Glasgow; the Antonine Wall, from Kinnell to Glasgow; the edge of the raised beach from Blackness to Falkirk; the shore line from Edinburgh to Stirling; the River Carron and road to Loch Coulter, from the shore to the Campsie Fells; the River Avon from the shore to the Sma'man Plateau; the Casterline Burn and road to Killyth.

These basic greenways, with short connecting links, would form a primary system which would extend to form part of an inter-regional one (already initiated in the Lothians). In the urban areas it would also develop a secondary pedestrian system connecting it to districts and residential environmental areas. In the rural areas it would branch off into a network of pathways meandering throughout the arable farmlands and over the moors. Where possible, sites of architectural, historic or scientific interest should be accessible from the system. These would include Blackness Castle, Roman Fort sites and sections of the Wall, Inveravon Tower, Kinnell House, James Watt's Cottage and Dunmore Village and harbour.

### Golf Courses

Studies in the Lothians showed that golf course provision should be at the rate of one per 16,000 of population. This would mean an increase of almost 10 golf courses within the next two decades if current demands persist. It is proposed that one golf course be developed at a time, situated in poor soil areas. Good road accessibility is more important than good land. Proposals have been made for new golf courses at Newlands, Kinnaird House and Knowehead. Other suitable areas are to be found on the Sma'man Plateau and the Denny Muir areas.

### Allotments

Two interesting trends may be observed in today's pattern of urban land use: the development of high-rise structures and their associated population densities and the decline of the traditional vegetable allotment. Modern European towns are developing a system of private gardens more in keeping with current needs. In Holland, large areas are divided into individual plots, each with a chalet and water supply and served by a central car park with toilets. These "Volkstuinen" enjoy security of tenure and meet a demand from garden enthusiasts living in

flat. The time may have come to consider such a scheme, possibly in the area north of the railway at Skew Bridge, between Falkirk and Larbert.

## REHABILITATION

There are few occasions when rehabilitation is undertaken for its own sake; a more obvious principle is to integrate functions, and so produce dual or multi-beneficial results. An example is the combination of refuse disposal and floodland reclamation, with the consequent improvement of agriculture. Proposals for dealing with all sites requiring treatment are given in Appendix No. 5: Rehabilitation Areas.

### Type 1—Bings

The present process of clearance should continue, and be accelerated where possible. Since many of the bings contain materials of value, their disappearance is assured. This factor alone is likely to prevent their purchase by the local authorities, unless as in the case of Grangemouth and Bing 1/1 the benefits outweigh the costs. There are no large bings of monumental importance which could justify retention on historic, scientific, sentimental or aesthetic grounds. The small bings associated with the early industrial age are unobtrusive and no special efforts need be made to remove them.

### Type 2—Tips

With a possible output of spoil and refuse for disposal in excess of 200,000 tons annually, a coordinated policy of tipping and reclamation will be necessary. As stated in the section on Public Utilities, it is proposed that there should be a Waste Collection and Disposal Authority. This body, in addition to the duties of collection and processing, should own and manage tips, collect dues, and direct the various forms of waste to strategic areas throughout the Growth Area. The choice of tip for any particular waste will depend on the factors of accessibility, toxicity, compaction, rates of decay and after use of the site. It is suggested that the following areas should be used:

- 1 In the west: the derelict sand and gravel area and surroundings, between the A875, the Forth and Clyde Canal, Bonnybridge and the Castlecary roundabout (approx. 450 acres).
- 2 In the east: the existing tip of Kinnell, extending westwards within the sea wall to Kinnell Kerse (approx. 250 acres).
- 3 The area immediately north of the River Carron between the A905 and the dyke on the shore (approx. 300 acres).
- 4 The Red Roses Tip and adjoining low lying area to the east (approx. 50 acres).
- 5 The Cammair area, where the filling of a number of large depressions would result in a moderately flat area of over 250 acres.
- 6 Future areas could include those mentioned in Type 11, The Foreshore.

Existing tips present a problem, and efforts should be made to divert material from the large tipping sites, which will take decades to fill, to these smaller ones where the effect could be immediate. There are many small tips round High Bonnybridge; some next to badly drained land which would benefit from infilling. It is suggested that, where possible by negotiations with manufacturers, these tips be

spread, possibly in the disused reservoir, and covered; or removed to the Bonny Water site; and that arrangements are made for future waste materials to be carted there or elsewhere. This should be a responsibility of the Waste Disposal Authority.

#### Type 3—Derelict Sand and Gravel Quarries

A survey is expected shortly to assess the value and extent of sand and gravel deposits. It will be conducted by the Scottish Development Department, the Ministry of Public Building and Works, and trade organisations. Maps No. 10 and 11, "Draught Geology" and "Soils", show the areas in which workable deposits are most likely to occur.

Two major alternatives are possible after extraction has taken place:

- 1 backfilling, possibly with waste material, covered with overburden, and a return to agriculture;
- 2 the creation of water-filled pits.

In the first case, co-operation with the Waste Disposal Authority will be essential to prevent a protracted process of infilling, which could create a nuisance lasting for years. In the second case, which is most likely to arise in areas with high water tables near the rivers, a landscape development plan will be needed. In either case planning permission should be dependent on satisfactory guarantees, and securities, which could include an accumulating retention fund from royalties on tonnage, to be used for rehabilitation purposes.

Only the results of the survey will show the potential of the area.

#### Type 4—Disused Railways

It is suggested that, with the exception of the section west of Bonnybridge, the old mineral railway system should be removed; it is not otherwise; is mainly on poor soils; and eventually may be of value for recreation or other purposes.

#### Type 5—Derelict Sites and Waste Ground

There are three extensive areas, each containing a variety of elements in need of treatment. It is proposed that they should be declared Comprehensive Rehabilitation Areas.

- 1 The Bonny Water area, from the Dock, eastwards to Caerlaverock House (approx. 50 acres).
- 2 The Bonny Water area, between Dennylochhead, the Forth and Clyde Canal, Bonnybridge and the Cisticola roundabout (approx. 200 acres).
- 3 The High Bonnybridge area, containing the fireclay and brickworks and their tips, waste ground, derelict buildings (approx. 150 acres).

Proposals for the Bonny Water area are also included in Type 6, and in the section on Recreation. Proposals for the Bonny Water and High Bonnybridge areas are also included in Type 2.

#### Type 6—Ponds, Harbours, Canals

##### Ponds

The ponds in Grangemouth are already included in a rehabilitation scheme initiated by the Borough Council.

#### Harbours

It is proposed that the harbour at Bonny Water should be rehabilitated to provide a suitable site and surroundings for a marina, and other associated recreational activities.

The initial problem will be to provide, at a relatively modest cost, the minimum facilities necessary to attract people to the Area. A phased programme of dredging, with a floating quay for easy embarkation, might be considered.

The fluctuations of tide seldom coincides with the needs of shift workers or others with inflexible timetables, and a 24-hour easy access to sailing water will be essential.

The advantages of Bonny Water are its accessibility; existing facilities; potential for improvement; existing nucleus of pleasure boats and a large expense of open water.

There is also an attractive mooring at Dunmore, currently used by commercial salmon fishers, and its possible development as a boating centre should not be excluded.

##### Canals

It is proposed that public access to the canals should be recognised, and that the footpaths and associated areas should be properly maintained and other necessary safety precautions taken.

The anomalous situation which allows the public access on the one hand, without accepting responsibility for safety on the other, is self-defeating. With improved maintenance, and a higher rate of public use, self-policing would reduce the risk of vandalism and increase the safety factor.

The Union Canal would be improved if the level of maintenance was as good as that of the Edinburgh section, where it is an asset to the amenities.

Adequate provision should also be made for a pedestrian and portage link between the Forth and Clyde Canal and the Union Canal to Falkirk.

#### Type 7—Derelict Stone Quarries

Although one quarry is listed in Appendix No. 5, Rehabilitation Areas, there are in fact many small quarries. They should not be regarded as automatic choices for tipping sites. Many have a potential for picnic sites; some may be of geological interest, or support a small local biological population worth preserving. It is for the conservation and use of such areas that the appointment of a person to co-ordinate regional recreation resources is so essential.

#### Type 8—Pit Shafts and Areas liable to Subsidence

This problem is dealt with in the Chapter on Mining and Subsidence. It is another example of a situation in which co-operation between development and waste disposal could be advantageous. Many pit shafts were not filled in, but only plugged near the surface. After surveys have proved their location, they should be opened by drags and then backfilled with bindstone.

If the long term plans for coal extraction take effect, a lowering of the surface on parts of the coastline may be expected; the amount depending on the rate of extraction. A tipping programme worked out between the N.C.B., farmers and Waste Disposal Authority could anticipate that result and maintain the necessary elevations for productive agriculture.

#### Type 9—Land liable to Flood and Badly Drained Areas

Some of these areas have already been included in the proposals for Type 3, Tups. These set many across

throughout the farmlands which are badly drained. Certain types of improvement have been mentioned in Type 10. Where the inhibiting factor for drainage is topographic, such as a hollow, a technique of filling with spoil, pulverized refuse, soil and decomposed organic matter could be adopted. The central waste authority would be invaluable for liaison between farmers, the Department of Agriculture, and those with spoil for disposal.

#### Type 10—Poor Quality Soils

On the southern fringe, an area of about 40,000 acres, known as the Slemishman Plateau, at present supports a rather precarious type of marginal agriculture, and a farming community with severe social and economic deficiencies.

The part within the Growth Area has been surveyed by the Macaulay Institute for Soil Research and parts of it classified as Land Use Capability, Class 4. This means that it suffers from severe limitations, which restrict the choice of crops, and which require special cultivation practices; two facts to which farmers will testify. These limitations are due to the nature of the clayey soil, which impedes drainage and prevents root formation, and the severe climate, which is partly due to the lack of shelter.

So large an area, lying between the most densely populated parts of Scotland, has not failed to attract the attention of improvers, and many attempts have been made to reclaim its unproductive acres. Both the Forestry Commission and the Department of Agriculture are currently engaged on research into planting and drainage techniques.

Basically the problem is to change the nature of the soil from an impenetrable, impermeable clay which holds water tenaciously and sheds the surplus rapidly to a workable soil with a crumbly structure which will allow water to percolate through it, at the same time retaining enough for plant growth. This can be done by increasing the pore spaces within the soil, either chemically by lime, or physically by the incorporation of rough organic matter, or coarse mineral particles; and developing a drainage system to remove excess water.

A number of factors have perpetuated and aggravated the situation and inhibited improvements. These include the independent character of the farmers; the size of the farms which are usually too small to support the livestock and arable land needed to maintain a family; and the lack of capital necessary to make improvements.

Concurrent with this situation on the Plateau is the rapid expansion of urban development on the plain below which will continue to be achieved partly at the expense of agricultural land; and will bring with it increased demands for foodstuffs and recreational open space. It will also produce an enormous, and continuous, supply of waste for disposal. This onerous duty will oblige the Local

Authority to dispose of 20,000 tons of partly dried sewage sludge by 1986 and over 50,000 tons of domestic refuse each year.

Such wastes are traditionally burnt, taken out to sea, from whence they sometimes return, or buried. Recently, methods have been evolved to convert these noxious wastes mechanically and biologically into compost. By using this material for land improvement, there is a possibility of recovering at least part of the cost, which will in any case be incurred by disposing of these potentially harmful wastes. An analysis of random samples of compost is given in Appendix 6. It would be foolish to predict that compost is the panacea for which the Plateau has been waiting all these years; but there is enough evidence to suggest that the first phase of a rehabilitation scheme could succeed.

The details of this and other phases are expanded in "Process of Implementation: Programming and Urbanisation Policies".

#### Type 11—The Foreshore

It is proposed that the mudflats be used for the planned disposal of waste materials. This should be the responsibility of the Waste Disposal Authority, who could manage the tips and direct the placing of the various materials. Special precautions will be necessary on the seaward sides where hardcores or rock banks will be necessary to prevent erosion.

Two major alternative reclamation schemes are possible:

- 1 that after the necessary minimum levels have been reached (approx. 15 ft. o.d.), the final layer should be top soil, or treated organic wastes, to create conditions suitable for agriculture;
- 2 that the area need not end up as being totally flat, and relatively uninteresting, but that the opportunity be taken to create an entirely new landscape of mounds and linked lakes, with varied woodlands and a wide variety of land uses.

Any scheme of tipping should not prejudice the possible expansion of the docks, or the new deep water channel and entrance.

The area north of the river is approximately 1,000 acres in extent; the area east of the docks approximately 1,200 acres; and the area between Bo'ness and the River Ayr approximately 350 acres.

#### Type 12—Polluted Rivers

The Secretary of State for Scotland has made an Order under the Rivers (Prevention of Pollution) (Scotland) Act 1951 and 1965, fixing 2nd November, 1966, as the appointed date after which it will be unlawful to make any discharge of trade or sewage effluent into rivers, streams, and tidal waters without the consent of the appropriate river pollution authority. In view of this order, it would be superfluous to make further proposals.

## 3. Infrastructure

### PUBLIC UTILITY SERVICES

#### Electricity Supply

Although sufficient generating capacity will be available for the proposed development, close liaison

should be maintained with the Electricity Board on the detailed programme. As development takes place, the opportunity should be taken to reduce and simplify the overhead transmission lines in order to improve amenity.

## Water Supply

The following recommendations are made for the Growth Area which should be provided with a high standard of potable water.

Concerning the future supply of water for industrial purposes, the value of the Forth and Clyde Canal is at present in the abstraction and return of water for cooling purposes. By special treatment this water could be made less corrosive and suitable for industrial use, and would thus relieve the demands on the mains supply. Further use and re-use of canal waters would be permissible within certain limits of temperature. The abstraction of industrial water without return should be strictly controlled, as it could affect natural water courses outwith the area of the Forth River Purification Board.

In 1963, the Scottish Water Advisory Committee's report on Central Scotland's water service recommended that local water authorities should be amalgamated to secure an efficient and economic supply of water adequate for all purposes to satisfy present and future demands. This recommendation is supported as it is appropriate for tackling the present piecemeal growth of water services.

When dealing with the water services within the boundaries of the Grangemouth/Falkirk Growth Area, the Advisory Committee put forward the following recommendations:

From source to tap the regional water board or its equivalent should be responsible for the unified control of the supply and distribution of water in the whole of the landward area and the burghs of the County of Stirling.

Grangemouth Town Council should become a constituent member of the regional water board suggested for Stirlingshire and Clackmannan, and responsibility for the Loch Turret Water Board's undertaking should be transferred to that Board.

The Burgh of Bo'ness should be integrated with the rest of West Lothian for water supply purposes, in whatever regional water area the County may be included.

Support is also given to the Advisory Committee's general recommendation to adopt a form of regional organisation necessary to secure the maximum co-operation and flexibility in the supply and distribution of water throughout the Area, maximum efficiency in management and administration, and the greatest possible simplicity in the shape of the structure.

The Services Working Party consulted local Water Authorities on regionalisation and found general agreement. This was particularly evident in the case of the Loch Lomond scheme, designed ultimately to supply Central Scotland with 100 million gallons a day. The first phase could be in operation by 1969-70. A new regional water authority should ensure that adequate supplies could be obtained from this source, to meet any exceptional requirement for industrial development.

## Gas Supply

Although a sufficient supply of gas will be available for the proposed development, close liaison should be maintained with the Scottish Gas Board on the detailed programme.

Industries with a very high consumption of gas could be located in the Area, but should be sited near the supergrid.

## Refuse Disposal

The planned population groups of the Area would produce the following estimated quantities of domestic refuse:

Area	Domestic Refuse <sup>(1)</sup>	Paper <sup>(2)</sup>	Food Waste <sup>(3)</sup>
Falkirk	15,100	1,150	750
Grangemouth	7,000	500	350
Bo'ness	5,600	300	250
Denny	9,300	550	450
Lauderston	4,650	300	225
Larbert	9,300	550	450
Bonnybridge	2,800	150	125
Totals	53,750	3,500	2,600

<sup>(1)</sup> Based on Falkirk Burgh's present rate of collection.

<sup>(2)</sup> It is assumed that the separate collection of paper will continue to be commercially justifiable and will be introduced throughout the Area.

<sup>(3)</sup> At present food waste is only collected separately in Falkirk where the present demand of six hundred tons per annum is probably the limit of the market for the Area as a whole.

The total quantity of domestic wastes to be disposed of within the Area by 1985 is therefore estimated at around 57,000 tons per annum.

In the past, local authorities generally have confined themselves to the disposal of domestic refuse. Today, a new situation is emerging which calls for improved facilities and for extended responsibilities covering the methodical disposal of larger quantities of wastes from non-domestic sources, such as:

## Spoil from Demolitions and New Construction

The Burgh of Falkirk at present disposes of over 50,000 tons, and it is estimated that the developments expected within the Area will produce some 400,000 tons per year.

## Trade Wastes

Several industries in Grangemouth disposed of their various wastes on the Forth foreshore mudflats in an unsatisfactory manner, and it is only recently that this has been discontinued because of the facilities offered by Grangemouth Burgh. New industries producing trade wastes are likely to be attracted and facilities for the efficient disposal of their wastes must be provided.

## Garden Refuse

The collection and disposal of garden refuse is a service which is being increasingly provided by local authorities. It is a service which should be provided to satisfy the public demand and also to discourage the nuisance caused by the burning of this material in open fires.

It is estimated that some 12,000 tons will need to be disposed of annually.

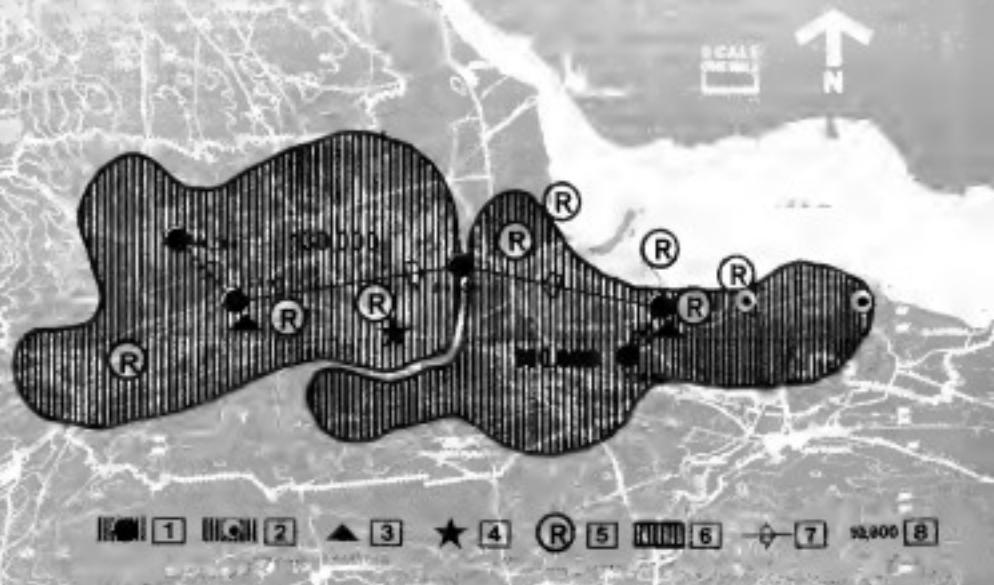
## Combustible Debris

The volume of wastes which can only properly be disposed of by burning (furniture, mattresses, carcasses, etc.) increases steadily, and facilities will be required to deal with this problem.

## Sewage Sludge

Provision is now being made for treating all sewage within the Area to meet the requirements of the Rivers Prevention of Pollution (Scotland) Act 1965. Some 150,000 tons of sludge will need to be dealt with per annum, but this may be reduced to 20,000 tons by dewatering. Only a fraction of this partially dried sludge could be disposed of through agriculture and other provision must therefore be made for disposing of the greater part. (See Drainage Proposals).

Therefore, the total quantity of wastes of all kinds which will have to be disposed of will, on the above basis, be around 500,000 tons per annum.



Considering the scale of the problem, recommendations are as follows (see Map No. 70, "Refuse Disposal Collection and Major Tipping Areas"):

An overall rationalisation of refuse collection, street cleaning and snow clearance operations should be adopted. To this end, greater consideration should be given to the standardisation of vehicles, street furniture, depots and other equipment.

The tipping of crude refuse should be discontinued.

A Grangemouth/Falkirk Area Waste Collection and Disposal Authority should be appointed to deal comprehensively with the problems outlined above, to take responsibility for public cleansing duties by the present separate authorities, and to have powers to acquire land suitable for rehabilitation by the controlled use of suitable wastes.

A joint committee should be set up with membership from the above-mentioned authority and the appropriate planning authority, to co-ordinate the rehabilitation programme.

Refuse treatment plants should be provided at sites adjacent to (1) Rouchmire Sewage Works and (2) Kinnell Kerse, with possibly a third plant in the vicinity of Falkirk.

These plants should be erected in phases to meet the expanding requirements as they develop; ultimately the plants should contain provision for:

- 1 separation of salvageable materials.
- 2 burning combustible debris, diseased carcasses, etc.
- 3 dealing with surplus sewage sludge, should the need arise.

The existing incinerator plant at Falkirk should be made available for burning combustible debris, until the new plants are capable of dealing with these wastes, when the old incinerator plant should be abandoned on amenity grounds.

The processed materials produced by the plants should be utilised as outlined in the Rehabilitation Proposals.

## Drainage

In the light of the studies, several recommendations seemed appropriate for the development of drainage facilities (see Map No. 71: "Regional Policy for Drainage").

Foul and surface water drainage should be in separate systems, thus making treatment simpler although possibly more expensive. Separate surface water drainage systems should be provided specially where there are suitable points of discharge nearby and where foul sewage must be pumped for treatment.

Each case for treating foul effluent either partially or fully before discharge should be specifically examined, depending on the characteristics of the effluent and the type of adjacent developments. Discharge of untreated sewage effluents along the Firth waterfront should be eliminated, in particular at those outfalls located further upstream which endanger the amenity of beaches. The villages west of Grangemouth and especially industrial development should provide secondary treatment, giving over 80 per cent removal of pollution instead of sedimentation only, which gives from 30-40 per cent removal. Where industries produce drainage which is unsuitable for direct discharge to a watercourse, treatment should be enforced. In every case, outfall sewers should reach the low water mark, beyond the tidal mudflats, and therefore some existing sea outfalls should be extended. In the Bonnybridge area, because of the reduced capacity of the sewage works

and the high degree of amenity provided by the Bonny Water, the establishment of industry would require careful selection with emphasis on using little or no process water which cannot be purified before discharge. In the long term, as the Area develops, a higher standard of treatment will be required.

The centralisation of drainage works is recommended, making the maximum use of the existing and proposed works, which should be expanded if necessary. Nevertheless, for economic reasons, extensions to existing drainage areas should be limited and, as far as possible, small outlying villages should be served by local works.

During the analysis of drainage possibilities, several cases for joint schemes were envisaged, of which that proposed by the Denny Burgh-Sterling County Council offers the best example. According to the development proposals, the various possibilities for draining some 1,000 acres east of Denny, lying partly within the boundary of each authority, were analysed. Agreement was reached on the possibility of providing a joint gravity system, draining towards the Denny sewage works, with its present design capacity (15,000 population) forming the first stage for subsequent increases in capacity of similar units, as development proceeds in the county landward areas.

The problem of flooding, particularly in built-up areas, should receive priority. Flood prevention schemes should be promoted, diverting flood waters originated by high tides or heavy rainfall. As in Grangemouth's low lying areas, extensive pumping should be undertaken where necessary.

All drainage schemes should be co-ordinated to ensure an efficient high standard of implementation, and the optimum use and administration of drainage facilities, regardless of the restrictions imposed by Local Authority boundaries. A single drainage authority might best be suited for this task.

## COMMUNICATIONS

### Roads System

#### Traffic Policy

The road system outlined on Map No. 72, "Recommended Road System", provides a solution to the traffic problems likely to arise. In evolving this solution, due consideration has been given to road proposals already committed or being developed by the Central and Local Authorities.

The provision of this road network is closely related to land-use proposals and should satisfactorily provide for all vehicular movements, and simultaneously safeguard the urban environment from traffic danger and nuisance.

#### Recommended Road Network

The three main routes of the National Road System (Red roads) were determined before the Study began, but some modifications to junctions are recommended to channel the longer trips into the National System, thereby discouraging overloading and undesirable short-cut movements via the distributor roads.

The total flow in a 16 hour day in 1986 to and from the Area on the A80, A801 and A803 roads would probably exceed 90,000 p.c.u.'s. When the A80 road is widened to dual three-lane carriageways, it would have a capacity of at least 50,000 p.c.u.'s. So that this route does not become saturated between its junction with the A876 road and Cumbernauld, consideration should be given to con-

structuring a major road from the A80 road at Castlecary to Glasgow via Kilsyth and Kirkintilloch. The connection of this road to national and primary distributor systems is designed to make it more attractive than the A80 road for traffic flows to Glasgow.

It is proposed that access to the Denny area should be by the primary and district distributor systems and that a connection with the Denny by-pass, near the Burgh, is undesirable; Denny-Scotting traffic would be able to continue to use the existing A80 road with greater convenience when the long distance traffic has been attracted to the new A80 road on its completion. The A9 road north of Glenbovie should be given a partial intersection with the M9 east of Pleasance and the M9 should be re-routed south of Pleasance to facilitate this. An intersection would not be required between the A9 road and the proposed alignment of the A876 road at North Broomsgrove. From Lethalbin a new road is proposed to the north to facilitate traffic movements to and from Grangemouth and Bo'ness. This would also give desirable linkages with the Livingston Growth Area. The primary distributor system would also be connected to the south of Lethalbin to give easy access to Falkirk and the west, and to divert traffic from the existing A9 road through Polmont.

The main feature of the primary distributor road system (Black roads) would be a major circuit round Falkirk area, with links from this to Denny, Skinflats, Grangemouth, Bo'ness and the national road system. An indication of the standard of road likely to be required in this system is given by the following examples of anticipated peak hour flows:

#### *Anticipated Peak Hour Flows*

Road	Peak Hour Flow (One Way)	Type of Road
Grangemouth-Bo'ness	1,800 p.c.u.'s	Dual two lane carriageways
Bathgate-King Road (Grangemouth Road A904)	2,000 p.c.u.'s	Dual two lane carriageways
Skinflats Area Ring Road	3,175 p.c.u.'s	Six lanes to include for turning movements
Bonnybridge Area-South of Falkirk	1,300 p.c.u.'s	Dual two lane carriageways giving capacity for the effect of external traffic

The district distributor road system (Blue roads) would generally follow the lines of existing roads, but most of these would require substantial improvement, and extensions in areas of new development. A major feature of this system would be a "one way inner ring" required to serve Falkirk's Town Centre; a 56ft-wide "all purpose" road carrying an estimated 3,600 p.c.u.'s designed for one way traffic to simplify junctions with existing roads. Its width should be capable of dealing with the flows obtained from the traffic assignment, providing that adequate car parking facilities are available near the points of entry to it.

The local distributor road system (Yellow roads) was not included in the traffic assignment study, but its requirements were considered related to Environmental Areas and are shown on Map Nos. 68 and 74.

#### *Traffic and the Urban Environment*

In allocating the various land uses, particular care has been taken to safeguard Environmental Areas from the harmful effects of unrestricted traffic flows. This has resulted in proposals to limit access to residential precincts in accordance with principles

set out by Professor Buchanan. These principles will also require implementation in the numerous redevelopment schemes to be carried out.

#### *Public Transport*

The recommended road network has been evolved on the principle that a high standard of public transport facilities would discourage the use of the motor car both within the inner urban areas and between central districts, industrial zones and the Environmental Areas. The primary, district and local distributor systems would provide a high standard of accessibility for public service vehicles on long and short journeys. The public transport service envisaged consists of a comprehensive network for buses, co-ordinated with improved railway services.

#### *Traffic Control*

The adequacy of the proposed road networks and the extent to which they would prevent traffic congestion depends on traffic management and the extent to which it would control private transport. Car usage in the main centres would require some restriction particularly through limiting the provision of car parking facilities. The establishment of a single transport authority to co-ordinate all these factors would greatly assist the achievement of a satisfactory network.

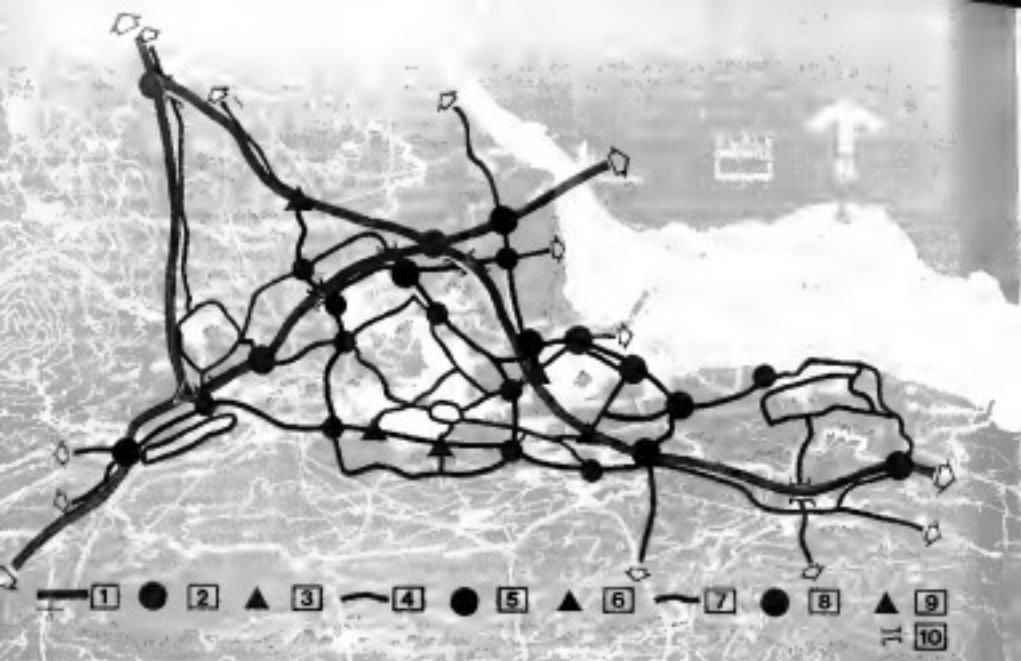
#### *Port and Canal System*

National policies for port development will have to cope with the demands imposed by modern methods of water transportation and techniques for the

handling of cargo. As the recent White Paper on Transport Policy (July 1966) states, "estimates of port requirements may have to be modified in the light of the container revolution, allowing containerised berths to enormously increase their capacity for handling cargo."

The adoption of the Rochdale Report's suggestion to establish a joint Firth of Forth Ports Independent Trust Authority to study the national and regional concept of future port facilities within the Firth is recommended. This scheme for the eventual unification of the Firth, proposed in 1962, is now well under way and should be the basis for the creation of a future regional port authority for Central Scotland.

The implementation of the proposed Grangemouth Dock three-year improvement scheme should proceed at an accelerated rate. The plan consists of the deepening of the approach channel, the construction of a new lock, two tanker berths for vessels of 25,000 tons dead weight, new quays for dry cargo ships and bulk carriers up to 25,000 tons dead weight, deep water quay for ships of up to 65,000 tons dead weight, and the reclamation of 20 acres of the Firth mudflats. The scheme was tabled for Government approval prior to the present Growth



Map No. 72: Recommended Road System

Key. 1. National routes. 2. Full movement intersection on national route system. 3. Limited movement interchange on national route system. 4. Primary distributor. 5. Full movement intersection between primary distributor and giving access to national route. 6. Limited movement intersection on primary distributor system. 7. District distributor. 8. Full movement intersection between district distributors or giving access to primary distributors and national route. 9. Limited movement intersection between district distributors or giving access to primary distributors and national route. 10. Bridge (fly-over).

Area concept being initiated, and should now be strongly encouraged in the light of the present overall development proposals.

Following additional industrialisation, further expansion of the port of Grangemouth is especially justified to serve the rapidly expanding petro-chemical industry and its allied trades. Land to the south-east of the new lock entrance already proposed to provide oil jetties for two tankers should be further extended and maintained solely by this specialised industry.

Proposals for industrial development in the proximity of the port are extensive, including provision for potential waterbound industry. The road and rail communication networks are also well provided for which would establish adequate connections between the port and its hinterland. Thus, attractive port facilities in themselves could generate additional trade far beyond that originally envisaged. This is especially so in the case of Grangemouth, considering its unrivalled centrality of location within Central Scotland, where today more than 75 per cent of the population and 90 per cent of Scotland's manufacturing capacity is within a short distance of the port.

The inland waterways no longer perform their original function of transportation. They form part of the drainage, agricultural and industrial water supply systems, while being used simultaneously for recreational activities.

#### Rail Facilities

The reappraisal of Britain's railway services is now taking into account the need to meet social, as well as economic and commercial needs.

Final decisions on the withdrawal of passenger and freight services could also be influenced by the recommendations of the Greater Glasgow and the Greater Edinburgh Transportation Studies and should therefore be postponed until these studies are completed. The railway network would benefit from an early rationalisation of freight transport services to reduce wasteful duplication and the scale of freight charges. Under-used and uneconomic sidings and "local" rail sections should be closed whenever they can be satisfactorily replaced by a more efficient road haulage system. The Bonnybridge and Greenhill Stations warranting closure under Dr. Beeching's terms of reference should be retained pending the examination of the planning proposals which locate substantial industrial development in their vicinity.

The transit depot proposed in the Falkirk area with improved facilities to Grangemouth Docks and adjoining industrial zones and to Edinburgh

Glasgow could beneficially be linked with the liner train network now being developed.

Rail facilities and car parking should be further developed at Falkirk (High), and particularly Falkirk (Grahamston), which is well located to serve the future urban, industrial and commercial potential of the regional centre.

#### Air Transport

There is evidence to show that the ease and frequency of movement provided by international air transit to and from Scotland has not been satisfactorily met. Scotland and its new growth areas lack vital services operating within Scotland to various parts of England and to the Continent.

One of the greatest obstacles to Scottish development is "travelling time", the time it takes to reach industrial centres. If these points could be linked together by an efficient air communications system, then industrial growth would be greatly encouraged.

The greatest weakness in air communications is with the Continent, where Scotland already sells more than one-third of her exports. There is no direct service to the Continent apart from the "tail-ends" of some transatlantic flights (all operated by foreign airlines) to the Netherlands, northern Germany and Denmark, leaving important industrial centres unserved. Because of their enormous industrial development and air linkages with other industrial centres, the Ruhr and Rotterdam should be main priorities for the provision of such flights.

The opening of additional domestic flight routes within Scotland are only likely to occur after an initial two to three year development period. However, as soon as a viable service from the Grangemouth/Falkirk Area to other industrial concentrations becomes evident, whether in Britain or the Continent, then a direct service, preferably from Turnhouse Airport, Edinburgh, should be provided. Such a service may require subsidy for the first few seasons until the route becomes fully established.

In order to introduce all year round direct domestic and air freight connections between Turnhouse Airport and the English Midlands, the existing runway should be extended, and a new cross-runway should be provided. This proposal should be expedited as soon as possible to meet the demands of larger planes and increase the reliability and use of services.

Further investigations should be made so as to ascertain the feasibility of establishing a local airport within the Growth Area. More encouragement could then be given to the executive aircraft and air taxi by providing local aircraft maintenance facilities.

## 4. Long-term Physical Growth (beyond 1986)

#### Main Long-range Planning Problems

Human settlements are in a continuous process of change, and at certain stages in their development most of them show a tendency towards longer or shorter periods of stabilisation. Methods can be introduced to control, accelerate or retard these processes; of these, the commonest form of presentation is the settlement Master Plan. For various reasons the conception and implementation of Master Plans usually have to be undertaken within a given period of time which does not always coincide with the natural rate and rhythm at which a town develops. Long term analysis can help to overcome

the difference between the conventionally imposed time scale and natural rhythm of growth.

Among other things the long-range Plan should consider the image of an urban settlement, or settlement system at that moment in time when the tendency to stabilisation of its growth and expansion may be expected. As has been shown, this would occur when such a settlement is confronted with a major threshold. At this point it would tend to keep within this limit (i.e., within the range of relatively normal costs for accommodating new inhabitants: see Phase Two: "Urban Growth Potential" and "Threshold Cost Assessment"). It is relatively

Map No. 72: Growth Possibilities Beyond 1986 Key: Urban Structure—1986. 1. National routes. 2. Residential and ancillary uses. 3. Industrial and ancillary areas (from population potential at 20 p.m.). 4. Industrial areas (from number of acres). Land not suitable for Urban Expansion. 5. Areas beyond the ultimate development threshold. Linkage - 2. Linkages with new community or new industrial areas. 6. Directions of further growth should minor become necessary.



SCALE  
ONE MILE

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simple to calculate the long-range Growth Potential and then the period of time needed for its realisation. By this method it is possible to deduce the date at which this tendency to "stabilisation" would start.

There are however a number of factors which make this prediction more difficult. First, as is usually the case, there may be several possibilities for development, and the tendency to "stabilisation" will appear at different dates according to the locations of the various main thresholds. On consideration of all these possibilities, a series of long-range growth potential figures will be obtained, indicating the various dates by which they will be met. In addition, when different urban standards (i.e. gross densities) are assumed, another series of alternatives will arise.

Where necessary, these alternatives should be analysed to propose a series of feasible long-range development hypotheses for the given settlement, or settlement system. This is helpful in deciding the optimum solution for the Master Plan, as it provides the opportunity for a rational choice of development areas. At the same time the urban structure proposals must retain a measure of flexibility to reconsider temporarily rejected hypotheses, which may nevertheless reveal advantages at a later date.

### Long-range Analyses in the Grangemouth/Falkirk Area Plan

#### Scope

Long-range problems were considered during the period of study, but the scope of long-range analysis was restricted by implications mainly caused by natural characteristics revealed in the Threshold Analysis, from which only one main threshold line (the Ultimate Threshold) was obtained. To overship this would be economically undesirable, and would require national level decisions.

#### Limits of the Growth Potential

The calculation of the growth potential within the Area revealed that there were only limited possibilities for the location of a large increase of population beyond the target figures for 1986 (230,000 population). This ultimate growth potential was first defined as about 310,000 (see section "Calculation of Growth Potential"). Later, studies into a feasible road system for the Area brought to light reasons against the further expansion of Bo'ness, even though it has a relatively large growth potential according to the Threshold Analysis. Taking this into account, the possibilities for urban growth within the Area in the post-1986 period would appear to be limited to some 270,000 as a desirable maximum.

Development for this additional population would be concentrated in new housing areas west of Denby (6,800); north of Larbert (6,000); and west of Greenbank (2,500). A new settlement (about 19,000 pop.), based on the substantial expansion of Airth, would be the only other feasible possibility for a large scale development.

#### Conclusions

However, since these expansions (even taking into consideration the development of Bo'ness up to 25,000 pop.) would be spread widely over the Area and constitute only 15-20% of the total population in 1986, it removes the need to build up a series of different hypotheses of development structure for the post-1986 period. If the directions of growth are to be kept along the lines defined by the Urban Structure Proposals during the next fifteen to twenty years, the main urban patterns would be well established and the remaining Growth Potential would not leave any significant opportunities for major alternative development schemes and the possibilities of over-stepping the Ultimate Threshold line are remote and unlikely.

Conclusions from long-range analyses on other vital problems do not necessitate any immediate solution. The Ultimate Growth Potential leaves a margin to accommodate the natural increase of population post-1986 within the Area for at least the next ten years. A decision at national level would then have to be taken, either to overship the Ultimate Threshold, or to look for other potential development areas in Scotland.

The proposed road network would still seem valid after completion since post-1986 growth would be mainly based on the expansion of the existing settlements, and it would be easy to provide them with appropriate links to primary and district distributors. Expansion would be relatively small, and the envisaged road capacity should be adequate to deal with future traffic flows. Airth (if developed) would be provided with an independent network and would have a separate link to the regional system. The expansion of Bo'ness might introduce major problems, and its development is therefore considered less desirable.

### Long-range Directions of Physical Growth

In view of the foregoing it was not felt necessary to construct a separate comprehensive long-range plan. Long-range directions of growth (see Map No. 73, "Growth Possibilities beyond 1986") were produced instead, which pinpoint:

- (i) the allocation of the Ultimate Threshold Line, by which the tendency to relative stabilisation of further growth can be determined.
- (ii) the possibilities for urban expansion beyond 1986 (within the boundaries of the Growth Area and its Ultimate Threshold Line) giving urban growth potential figures for all the areas involved.
- (iii) indications where studies should be carried out if the Ultimate Urban Potential is to be expanded within the boundaries of the Growth Area.
- (iv) directions in which urban expansion towards adjacent areas might be considered, thus necessitating further planning studies.

## 5. Conclusions

The studies demonstrate that the Grangemouth/Falkirk Area would be an attractive place for development. Physically there is room for planned expansion not only for housing and related community facilities and services; but it can also offer a choice of sites for industry to an extent rare elsewhere in the Central Belt of Scotland, and is particularly well-placed for regional and national communications. Expansion beyond 1986 can also be accommodated.

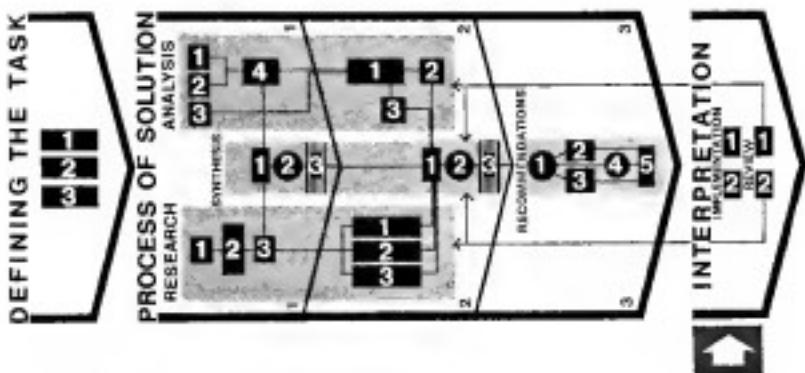
The recommended Urban Structure Plan shown on Map No. 74 has achieved the mid-term journey

to work, a choice of employment, services, attractive living conditions, wide opportunities for recreation, and an urban framework which would stimulate economic activity. By 1986, the Area would be an integrated urban complex formed from the existing settlements and focused on Falkirk as the main commercial and residential district. Expansion and development would take place by means of redevelopment, rehabilitation of old industrial sites, and revitalisation of existing residential areas, as well as by construction on undeveloped sites. The Grangemouth area would provide employment opportunities on a regional scale to become the major industrial concentration, although a secondary concentration would be located at Bonnybridge. Provision for leisure time activities would be made both within urban areas and in the countryside, focused on a new regional park near Falkirk. All development would be served by a new road network, providing links within and between urban

areas and to the national road system. Utility service networks would be modified and expanded to suit the new urban structure.

The success of this Plan lies in its satisfactory implementation. This type of integrated urban development requires a considerable co-ordination of authorities and would be accomplished more efficiently by a new level of administration. In Volume One it has been suggested that the main urban complex comprising Denny, Larbert, Stenhousemuir, Falkirk and Grangemouth should be administered as one unit under a single local government, either as a large burgh or a new city, and with powers similar to those of a new town corporation. The successful implementation of this Plan would establish a much-needed new pattern of living, and provide an environment to match the increasing standards of affluence and separateness of the future population.

# Interpretation of Recommendations



## Process of Implementation

### 1. PROGRAMMING AND URBANISATION POLICIES

**DEMOGRAPHIC BASIS:** Population targets—length of programme phases—the demand for houses and employment

**PROGRAMMING CRITERIA:** Implications from the Threshold Analysis on investment expenditure—construction rates for housing—the provision of industrial sites—existing commitments of the Local Authorities for residential, industrial and road development

**THE DEVELOPMENT PROGRAMME:** Construction rates for housing—provision of industrial sites—the development programmes for housing and industry—implementation of the road network—phasing of land rehabilitation

**URBANISATION POLICIES:** The need for guidance in the implementation of proposals—a policy for high buildings—a policy for middle-income areas

### 2. PROCESS OF APPLICATION

**ANTONISELL ENVIRONMENTAL AREA:** The site—in context within the proposals—densities and land uses—circulation—house types—programming

**FALKINE CENTRAL AREA:** Its context within the proposals—present character—need for change—opportunities for change—the planning concept—comprehensive development area—programming

The first section describes how the proposed development should be phased and implemented. Phasing would be based on the rising demand for houses and employment, the need to achieve a gradual build-up of the construction rate, and existing development commitments. The proposed development programme covers housebuilding rates, the provision of industrial sites, and the implementation of the road network in three phases. The

process of implementation will require guidance on particular aspects of urban development in the shape of policies for high buildings and middle-income areas.

The second section demonstrates possible solutions for two urban sites by means of detailed layouts and land use distributions, based on the proposed development standards and objectives.



## INTERPRETATION OF RECOMMENDATIONS

### Process of Implementation

## 1. Programming and Urbanisation Policies

### PROGRAMMING

Programming or establishing priorities is a necessary part of any long-term enterprise to predetermine investment rates; to enable decisions to be taken within a national framework; to ensure that the building labour force is available; and so that infrastructure requirements and programming of site investigations for the urban expansion can be predicted in advance of actual needs. Nevertheless any programming in this economy must be somewhat theoretical since Local Authorities cannot acquire land at will, nor can the timing of private development always be foreseen. The new unitary administrative structure proposed and the Land Commission's powers should help to alleviate future problems of this nature. A development programme must therefore aim to achieve the optimum sequence of urban expansion in the light of both socio-economic and planning targets.

### Demographic Basis

Volume One, Chapter 3 shows that the population in 1966 was estimated to be some 130,000, of which some 4,010 are persons resident in institutions, etc. By 1986 the total would be 229,200, of which 5,732 would be in institutions. These forecasts were based on the assumptions that: net emigration would cease by 1971; planned immigration would begin in 1971 and continue until 1986; the total number of immigrants would be 50,000; the rate of inflow would be constant, i.e. three five-year flows of 16,665; the immigrants would have the age and sex distribution of recorded Glasgow overspill; and after 1986, the population would expand by natural increase only.

Programming should sub-divide development into three phases: two five-year periods and one

ten-year period. On this basis the population expansion can be estimated to relate the housing demand, and jobs needed for the increase in workers in manufacturing industry (48 per cent of total workers are in manufacturing in 1966 but this figure would be 42 per cent by 1986). This is shown in Table 1.

### Programming Criteria

The expansion of the population will not ensure by itself that employment, houses and other components of the urban structure will be available when required. A number of criteria will affect the provision and siting of these facilities. Some of these criteria were revealed by the Threshold Analysis and related planning studies, others would be imposed by construction rates, and existing commitments of the Local Authorities for development. All these should be accounted for in the proposed programming framework in order to achieve the desired urban growth rate.

The Threshold Analysis defined land with economic potential for urban expansion (see "Threshold Cost Assessment") and its resulting influences on investment programming. Firstly, the opening up of one or more threshold areas to achieve the desired rate of population increase may lead to periods of exceptionally high investment expenditure by public authorities. This situation is undesirable as it makes budgeting extremely difficult. Secondly, the sequence in which development thresholds are tackled may have the same effect. If successive costs had to be met within a short period this might limit the population increase possibilities, and thereby restrict availability of labour for new industries. The over-stepping of thresholds should therefore be arranged in a sequence which gives a constant or graded increase in capital investment per year. This could be achieved by using the small pockets within first thresholds either to allow more flexibility at later stages or to allow a more rapid build-up of housing than would be possible in the case of opening up the major development areas.

It was shown that development at Larbert would be at the least cost. Denby would be the next most economic, but the size of expansion suggests it would be better deferred until growth is established more generally. Therefore, Falkirk should take precedence, especially since it is the focus of the Growth Area and would in fact receive approximately half the immigrant population in the surrounding districts. Further expansion of Grangemouth beyond 1970 would have to be accommodated outside the burgh in view of the restricted land

TABLE 1  
*Population Expansion (Private Households)*

Period	Population increase	Employment increase (in manufacturing)	Housing demand*
1966-71	7,070	1,485	2,080
1971-76	36,390	3,850	7,800
1976-86	65,870	7,215	18,750
	97,330	12,500	28,630

\* Assumes 2.4 p.p. family.

TABLE 2 Construction Rate: House Building 1965-66

Burgh	Houses completed in June 1965-June 1966				Calculated rate per 5 years
	L/A	SSHA	Private	Total	
Falkirk ...	26	—	21	47	235
Grangemouth ...	114	31	23	168	840
Bo'ness ...	181	—	—	181	905
Denny & Dunipace ...	30	—	—	30	100
Totals ...	341	31	44	416	2,080

Source: Housing Returns for Scotland.

available. Although Bo'ness shows a relatively high cost of expansion small areas of development could take place during the first two periods of the Plan.

Construction rates as well as investment rates must be adequate to meet the increase in demand for housing and jobs. Inevitably estimates may need to be revised over the 20 years. The present house building rate calculated from the Housing Returns for Scottish Burghs over periods of one year and of five years is shown in Table 2. The total will be slightly increased by house building in the landward areas.

To accommodate the rate of population expansion in Table 1, the above construction rate would have to be increased after the first five years to a rate higher than in any of the Scottish New Towns, although the total population expansion by 1986 is similar. It would be desirable, therefore, to even out the build-up of the construction rate and accelerate it immediately, especially in view of rehousing needs, elaborated later.

The investment costs for industry would be borne almost entirely by the private sector; thus it is not possible to influence industrial programming, and these costs would vary with the capital intensiveness of the industrial concern. The success of the Growth Area would therefore depend on the attraction of adequate employment, and the demand for this would build up with the increase in population (see Table 1). Employment projections showed virtual equality between the increases in the present working population, and employment opportunities at least up to 1976 and probably to 1986. Employment in new manufacturing concerns would be needed only for the immigrant working population and was calculated at 800 jobs per annum (all categories of employment) (see Volume One, Chapter 4).

Overlapping of demand for labour does not usually occur between factory and house building enterprises but where large scale industrialised housing is attempted, this might happen to some degree. Since factory building is a lengthy and more costly process than house building, sufficient land should be made available to industrialists well in advance of each stage of the desired population increase. It is proposed that some 50 acres should be available in advance of actual need at the first phase to anticipate the industrial build-up for successive phases, as well as to resite some non-conforming industries.

Planned redevelopment and expansion is a slow process which can hardly yield major results in the first five years. However, there are pockets of land already zoned in the Development Plans for industry and housing, which should be developed either within or soon after the first five years. These main commitments are listed by general locations:

#### Residential Areas

Callendar Park, Falkirk  
South Callendar Wood, Falkirk  
Kinnel, Bo'ness  
Burgh extension area, Denny  
Polmont House  
Bonnybridge  
Shieldhill  
Bowhouse, Grangemouth  
Bannock, Falkirk  
Summerford/Glenfuir, Falkirk  
Muirhouses

#### Industrial Areas

Carrieside, east Denny  
Whaleflats, Grangemouth  
South Skinfolds  
Lochlands, Falkirk  
Middiefield, Falkirk  
Orchardhall, Falkirk  
Daiderse, Falkirk

Programming should therefore take this into account, although some development would provide accommodation for slum clearance families rather than for the population increase. Many areas defined as suitable for redevelopment adjoining proposed main traffic routes should be used for road widening or realignment. Only about one third of all areas defined (mainly at Bo'ness and Falkirk) would be likely to be completely redeveloped for housing during the period of the Plan. However, the overall population displacement density (i.e. density of redevelopment areas) was calculated to be quite low (34 p.p.s.) and most of these people could be rehoused within renewal schemes at high densities adjacent to central areas. Redevelopment should be tackled quickly and much is already committed, since in addition to enabling rapid implementation of the new urban structure, it promotes the Growth Area image, as many central areas are ringed by twilight zones. Construction rates for housing should therefore be increased over the first phase to house both displaced families and to allow a general build-up of accommodation in readiness for the immigrants. Development should mostly take place in areas already committed for housing.

Both industry and residential uses would depend on the successful implementation of the infrastructure, and in particular, the road network which would connect and serve all the urban structure components. There are already commitments for

major road works. The sections of the National Road System at present being developed should provide the first phase of the ultimate road network. This consists of completion of sections of M9 and A876 (Paisley and Falkirk by-pass stage 1 and Bonnybridge/Lerbert by-pass) and should free the internal road systems of some of the heavy through traffic.

## The Development Programme

### *Residential and Industrial Uses*

Although the recommended programming will not specifically cover ancillary urban functions such as shopping, civic and community buildings, recreational areas etc., these should be phased to match the growing population catchments, preferably slightly ahead of demand, to eliminate the usual complaints of insufficient facilities in large new housing areas. The implementation of the shopping pattern would be particularly complex, and should be related to the redevelopment of existing centres as well as to the demand for new centres. Severe land use controls may have to be applied to achieve the desired balance in the hierarchy of shopping centres.

The demand for house building arising from the population growth has to be amended in the light of the programming criteria, although the actual population build-up would remain as in Table 1. The phasing of development should be increased in the first five years, mainly at the expense of the second phase, and this would give a satisfactory acceleration of the construction rate. By 1976 it would be similar to that at Cumbernauld and East Kilbride. Acceleration of the present rate would be required immediately and should be aided by the use of industrialised building methods. House building rates can also be translated into the number of Basic Units needed of 1,750 persons (approximately 510 houses).

The land required for industrial development was calculated from the estimates of manufacturing jobs shown in Table 1. Industrial estates were expected to include some service employment and warehousing. It was assumed that industrial densities are likely to continue to be low in the Grangemouth area and therefore 75 per cent of the total requirements (455 acres) were calculated at 5 w.p.a. and all other new industrial areas at 10 w.p.a. Again the first phase should be expanded. Rehabilitation plans at Bonnybridge should have priority starting at the Cumbernauld end so that alternative regional sites may be available to industrialists during the second phase of development. Industrial sites at Middlefield and Grangemouth are suitable for early use. Development at Skinflats would be likely to be a long term project.

The programming of development for residential and industrial uses is shown below in Table 3.

### Roads

A radical new pattern of roads was proposed, and its phasing would be related closely to traffic requirements and the growth of housing and industry. Traffic surveys carried out at Falkirk indicated that even after the completion of the M8, about three-quarters of the traffic now travelling between Grangemouth and Glasgow and entering the Burgh, would continue to do so. The southern section of the primary distributor circuit road should therefore have an early priority. Similarly, Falkirk's inner ring road should also be developed with complementary car parking provision at an early stage. In Grangemouth, priority should be given to both the primary and district distributor roads along the A964 and the road giving access to the docks.

The inherent dangers of traffic generation in the large long-term industrial area at Skinflats should be controlled by careful phasing, but would be facilitated by comprehensive development. The road network would be subject to further refinement by local traffic studies, especially since the Greater Edinburgh Transportation Study will need to be related to proposals for the Growth Areas.

The location of priority areas and the programming of development is shown on Map No. 75 "Phasing of Development" for residential and industrial uses and roads.

### Rehabilitation Programme

Rehabilitation of land is often a long-term process and should be carefully phased to make land available for development when needed. The vast problems caused by past mining activities may have to be tackled at each stage of residential development rather than in advance. Many smaller areas in the existing urban structure are already being rehabilitated and work on these and other areas proposed for open space or recreational use should be accelerated where the environment is adversely affected or danger is present. The proposals for rehabilitation of land for agriculture have been expanded in detail and a co-ordinated action would be necessary because of the number of different interests involved. The programme should be in two major phases as follows:

#### Phase One

It is proposed that the responsible local authority, in collaboration with appropriate organisations, embark on a programme to test the feasibility of using compost and other wastes for land reclamation on the Shireman Plateau, and elsewhere, by the following steps:

- Selection of suitably representative site, or sites of about 50-100 acres.
- Consultations with owners and occupiers.
- Trial plots and trial methods, using compost, etc., from suitable existing compost plants.
- Evaluation, cost benefit analysis, etc.

TABLE 3. The Development Programme

	Phase 1 1966-71	Phase 2 1971-76	Phase 3 1976-85	Total
Residential				
Houses ..	..	..	..	6,610
Basic Units ..	..	..	..	8.5
				6,618
Industrial*				
Grangemouth (acres) ..	..	..	200	255
Rest (acres) ..	..	..	100	260
				720
				1,475

\* Excluding Skinflats.



Map No. 75 : Planning of Southampton - Industrial and Residential Roads. Key: First Phase up to 1931: 1. Residential. 2. Residential. 3. Residential. 4. Existing roads, district and local, to be retained. Second Phase up to 1978: 1. Residential. 2. Residential. 3. Residential. 4. Existing roads, district and local, to be retained or improved. Third Phase: 1. Residential. 2. Residential. 3. New roads (proposed, started and built). 4. Existing roads, district and local, to be retained or improved.

## Phase Two

It is proposed that if Phase One shows promise, and if a reclamation scheme is within the realm of practical possibility and economic feasibility, then Phase Two should be undertaken by alternative means A or B as follows:

- A. The occupiers in the area should be encouraged to use compost, coupled with drainage, to improve their land, both arable and rough, by setting up a local authority contract service to carry out the work; the terms being adjustable as the demand increases until a stage is reached when local contractors can undertake the work as cheaply as the local authority. This might have a two-fold result, in that occupiers could themselves copy the methods and so increase the demand for compost, and secondly increase their costs to make use of the land improvements, which in turn should lead to profitability, and a self-generating improvement scheme.
- B. The local authority should purchase one or more contiguous farms to provide a suitable unit of 500 acres for rehabilitation in one block, to be undertaken as follows:
  1. Negotiations with owners, and purchase.
  2. Selection of Manager: either by employing a manager; or by offering the lease for tender, and selecting the most suitable applicant.
  3. Interim arrangements for farming the unit, while the survey is conducted, and plans prepared, etc.
  4. Detailed survey of area, to include:
    - a. Accurate levels,
    - b. Existing drainage system,
    - c. Soil survey: profiles, drainage class, chemical analysis,
    - d. Vegetation survey,
    - e. Local climate survey, by timer flags, rain gauge, etc.
    - f. Field boundaries,
    - g. Buildings, layout, age and condition (if not already complete),
    - h. Roads and tracks, access and internal,
    - j. Services, water, electricity, etc.
  5. Determination of principal land use/types of farming, etc.
  6. Preparation of Land Use Plan, to include:
    - a. Woodland Pattern shelterbelts, blocks, amenity, species, etc.
    - Based on Phase Two, 4c, 4d, 4e, 4f, 5, 6b.
    - b. Field Pattern, to give seven blocks of approximately 55 acres each, size, shape, disposition.
    - Based on Phase Two, 4c, 4d, 4e, etc.; 5, 6a.
    - c. Buildings and layout; domestic, utilitarian.
    - Based on Phase Two, 4g, 4h, 5.
    - d. Internal Road System.
    - Based on Phase Two, 4a, 4b, 5, 6a, 6b, 6c.
    - e. Fences, etc.
    - Based on Phase Two, 6a, 6b.
    - f. Services, etc.
    - Based on Phase Two, 5, 6b, 6c.
  7. Preparation and execution of Improvement Plan:
    - a. Drainage System, principal outfalls, ditches, leaders, tile and soak drains, etc.
    - Based on Phase One, 4.
    - Phase Two, 4a, 4b, 4c, 5, 6a, 6b.
    - b. Cultivation System, type of cultivations, rates of compost application, crops, etc.
    - Based on Phase One, 4.
    - c. Planting programme for trees.
    - d. Livestock System, numbers of head per year, etc.
    - e. Buildings—Establishment of a nucleus, which is then extendable.
    - f. Equipment, fixed, plant, machinery, etc.
  8. Evaluation.

## Phase Three

Selection of another 500 acre site, and possible sale of first site, manager being retained to hasten improvements from experience gained in Phase Two.

## URBANISATION POLICIES

In the Model Method of the Planning Process one directive at Stage III is concerned with the implementation of the planning proposals. To ensure this would be undertaken in the most satisfactory manner and create the optimum environmental conditions, some policies would be required to guide specific aspects of urbanisation.

Private building development is likely to be a continuing part of our economy and tends by its nature to be unrelated to wider social and aesthetic aspects of each particular urban area. Building by-laws, factory acts, etc., ensure building safety and the adequacy of local measurable conditions, but individual buildings or groups of buildings exert a wider, unmeasurable influence. Therefore, policies have been formulated for two special aspects of the environment to guide proposals for high buildings and the distribution of middle-income residential development.

### A Policy for High Buildings

High buildings are usually proposed in connection with residential or office development, but do not necessarily indicate high densities. A flexible policy is therefore needed as a guide to conditions under which high buildings would be an attractive addition in urban areas.

Firstly, there are certain basic conditions which must be met in respect of the physical location of the block. Social requirements and the development objectives dictate that the concentration should increase towards centres of settlements; and that high density dwellings should be located within suitable areas indicated by the "Data and Analytical Studies: Intensity of Development" and close to shopping centres. High buildings should be in locations acceptable climatically as regards wind, temperature, aspect and air pollution. Physical ground conditions will influence possibilities for heavy building structures, and in view of the extensive areas of past mining activities, local conditions will need to be investigated thoroughly in each particular case. The development should also comply with local standards for densities, plot ratios, daylighting, parking, servicing, etc. Generally, maximum densities or plot ratios would only be acceptable where maximum accessibility is possible.

Secondly, the standard of design of each block, its finishes and position in the townscape should not be merely acceptable, but a worthy contribution to the urban scene. The most satisfactory relationship of high and low blocks and open spaces is most likely to be achieved by means of comprehensive development schemes. Skyline should be considered with care, particularly where structures of historic or architectural interest are adjacent, when there may be a problem of domination of existing spires, or well-loved silhouettes by a new scale of development. One solution may be to keep these old and new features apart. Particular advantages can be gained from the use of lower blocks to identify districts, central areas or open spaces especially from a distance. Tower blocks are more satisfactory in the townscape than slab-blocks since they are non-directional and produce less overshadowing.

High buildings are not the only solution to high densities or plot ratios, for linked slab blocks of medium height may be just as functional. However, extensive areas of these may also have a significant impact on their surroundings.

It can be concluded that the ultimate decision on each application will finally rest on the quality of the scheme especially in visual terms. The onus will therefore be on the applicant to make out a case for a high building, and for this reason early consultations with the planning department will be advisable. Models of the scheme may also help to "test" the development visually. Even though it is not possible to define specific locations for high buildings there are several areas which do not fulfil the conditions outlined above and are therefore unsuitable for high buildings. This restriction will therefore constitute an important policy for the following areas: Bonnybridge, Shieldhall, California, Rumford, Ranknock, Airth, Brightons, Polmont, Laurieston and Grangemouth.

#### A Policy for Middle-Income Areas

Middle-income housing is scattered throughout the existing urban areas, and a considerable amount of private building is taking place. Some indications of the demand for additional areas of this type of development have been shown in Volume One, Chapter 7. It is desirable that a number of sites should be allocated within new development areas in order to achieve a broad distribution of social groups and to give a choice of sizes.

Many factors will influence site selection and few can be quantified. The same social conditions for development must be met concerning micro-environment traffic circulation, and provision of community facilities as for other developments. Since car ownership rates are likely to be high, proximity to district shopping centres will not be a major influence on location, and outlying sites with less easy access to main urban areas will be suitable. No private schools exist in the Area, but it is known that pupils travel to Edinburgh, Glasgow, Crieff, Dollar and Bridge of Allan, and this would make the northern part particularly convenient for access to these facilities. Densities of middle-income housing are likely to be in the lower ranges and suitable areas for low densities have already been defined in the "Intensity of Development" Study.

It is difficult to predict exactly where it will prove attractive for middle-income housing, but existing areas are likely to stimulate further development. Polmont is only a short rail journey from Edinburgh and this in part explains its present attraction. The ultimate decision will depend on the quality of the design and layout of the housing scheme, but there are some areas which are especially suitable and can reasonably be expected to accommodate middle-income development, such as: Polmont, Denny, Torwood, Stenhousemuir and Greenbank. There are also several areas which cannot meet the required conditions and therefore extensive development of this type should be discouraged in Grangemouth, Rumford, Brightons, Shieldhall, California, Bonnybridge, Banknock.

## 2. Process of Application

The scale of the recommendations do not generally allow detailed proposals for individual sites or urban areas, and implementation within the Growth Area's framework will be largely a matter for local decision and policy.

However, it was considered that some indication could be usefully given of the way in which the broad principles laid down for development could be carried out, and so give a glimpse of the likely future prospect of the Area.

Two types of development were chosen as test cases for the application of the design principles at the local scale outlined in the Research Studies within the wider context of the Recommendations. These were: a typical residential environmental area at Antonshill, north of Stenhousemuir, and the regional shopping and commercial centre at Falkirk.

### ANTONSHILL ENVIRONMENTAL AREA

#### The Site

Roughly rectangular and approximately three-quarters of a mile by half a mile in size, Antonshill site lies to the north-east of Stenhousemuir and is bounded on the north by Belladyke Road, on the west by Tryst Road, on the south by King Street, and on the east by the northern continuation of Alloa Road. (See Map No. 76, "Antonshill—Location in the Region"). The ground rises some 50 feet at the north-east corner of the site and affords views south towards the Slemishane Plateau and north to the hills of Fife. The area is bisected by the Chapel Burn and one of its tributaries and has an eight-acre cemetery located near its centre. The possibility of subsidence from past mining activities would necessitate careful foundation design and

low-rise building on a small part of the site to the south-east, whilst the presence of an underground water main is also a restriction.

One-third of the site is at present occupied by a golf course, cricket and football grounds. There is an area of new housing immediately north of King Street with small pockets of older dwellings on the northern and eastern boundaries. The remainder of the site is agricultural land with farm buildings at Antonshill and Muirhead. (See Map No. 77 "Antonshill—Site Influences").

Taking into account the cricket and football grounds and some 10 acres of recent housing, the area remaining for development is 123 acres.

#### Growth Area Proposals

##### Road Framework

A primary distributor road would be located to the west of Antonshill and it is proposed that King Street should become a district distributor road. Belladyke Road and Tryst Road would become local distributor roads. A secondary school is proposed for the eastern end of the Antonshill site. Its playing fields would act as a buffer zone against traffic noise between the primary distributor road and the housing.

##### Basic Units and Community Facilities

It is proposed that three Basic Units each of 1,750 persons be located at Antonshill. These would form one Catchment Unit and would support the following community facilities: local shops, public house and cafe; primary school and three nursery schools; local park and three children's parks.



Map No. 76: Antonashin—Location in the Region

Antonshill with its population of 5,250 falls into the category of the minimum size of Environmental Area as defined in the Chapter "Towards an Ideal Urban Environment".

## *Design Principles*

Design principles outlined in the Research Studies should be adopted to achieve a satisfactory environment. These include: safe circulation on foot achieved by an independent network of foot-paths, sheltered if possible; access roads to houses which only carry for residential traffic; off-street parking for each dwelling in addition to garaging; use of MOHDLG sunlighting and daylighting standards; no north-facing gardens; each dwelling having access to private open space; maximum number of dwellings on the ground; a maximum choice of dwelling types meeting different sizes of family; exploitation of existing topography and vegetation to give identity and interest to the lay-out; and adequate open spaces and community facilities, integrated with the pedestrian network.

#### Density Distribution

Although there are no factors which would justify a major departure from the average density of 45

p.p.s. for new developments, a modest increase in density is proposed on the grounds that the site enjoys a southerly aspect; has no soil bearing problems except for the small area mentioned above; is part of the main urban complex around Falkirk, and is close to a District Centre.

Of the 122 acres available for development, community facilities for three Basic Units would occupy the following areas:

Children's Parks	-	-	-	12 acres
Local Parks	-	-	-	20 acres
Primary School	-	-	-	4 acres
				36 acres

This would give a total of 86 acres available for housing, and at an average net density of 60 p.p.a. a total population of 5,280.

Since a range of different house types would be provided, 60 p.p.a. would be the mean density of a spectrum of higher and lower densities. Thus parts of the site would have a density of only 30 p.p.a. whilst the areas of flats, if considered alone, would have a density of up to 100 p.p.a.

The density distribution across the site would be determined by the following factors:



Map No. 77: Antenshaw—Site Influences

Key: 1. Primary distributor road. 2. District distributor road. 3. Local distributor road. 4. Area affected by mining. 5. Water main. 6. Panoramic views. 7. Prevailing winds.

Proximity to local facilities: the flats enjoy the easiest access to shops, primary school and the largest areas of open space to compensate for lack of private gardens. Because of its distance from local shops the north west corner of the site has been chosen as the lowest density zone; this area could accommodate private development for middle-income families on the assumption that there would be a higher than average car ownership and that individual garages would be attached to each dwelling and not grouped as elsewhere.

Topography and orientation: south-facing slopes ease the problem of ensuring adequate sunlight and are therefore suitable for denser development.

The increase in density towards the centre of the site suggests an increase in the scale of spaces in the pedestrian hierarchy; higher buildings enclosing wider spaces. This would reduce the number of pedestrians living near the distributor roads and might reduce the number of people tempted to wander on to these roads whilst fewer people would be subjected to the noise generated by them.

#### Pedestrian Circulation

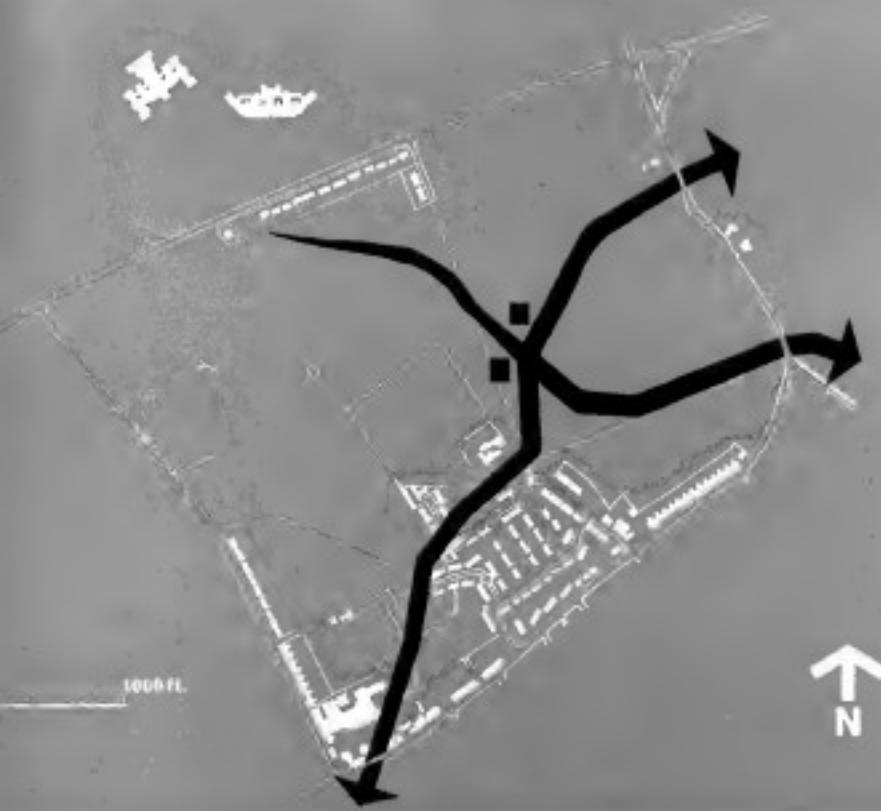
Pedestrian movement would be independent of the road network—there would be an hierarchy of

pedestrian spaces, starting with that in front of every dwelling and progressing to the areas of parkland in which would be located the community facilities: the local shop, primary and nursery schools and playgrounds. (See Map No. 78, "Antenshaw—Main Pedestrian Routes".)

The principal pedestrian routes would be based on desire lines and determined by two factors: the location of district and local facilities; the topography of the site, particularly the routes of watercourses. (Waterways are an important linear element in the greenway system.)

Thus one main route would connect the district centre, local shops, primary school, and the secondary school, whilst a second route, following the burns, intersects this at right angles near the local centre. A network of pedestrian ways would then build up, spreading out towards the perimeter of the site and terminating in the four bus stops located at 1,200 foot intervals along the local distributor road. All dwellings would be within a quarter of a mile of a bus stop.

In addition to the main fair weather paths which would run through parkland, an attempt has been made to provide alternative foul weather paths which would be sheltered by buildings and partially covered.



Map No. 78: Autonhill—Main Pedestrian Routes

Children's parks, nursery schools and the primary school would not be treated as isolated elements but as events within the continuous open space of the principal pedestrian routes.

#### Vehicular Circulation

Except on the southern flank, the existing road system around the perimeter of the site would be adapted as a local distributor road. The only completely new road would be a short length which runs parallel to the proposed King Street district distributor. This would enable the existing dwellings on the north side of King Street to be served more easily from the local distributor system; later, if the sites were redeveloped, any new buildings could possess sound insulated frontages on to the district distributor. Access would be restricted to the local distributor roads and the whole of the Autonhill area, free of through traffic, would be served by 12 cul-de-sac roads of varying length. (See Map No. 79 "Autonhill—Road System".)

The traffic flows on the local distributor and the culs-de-sac have been estimated for the 1966 evening peak. The calculations are based on: 1·2 cars per family; 50 per cent work journey car usage; 1·2 persons per car; 20 per cent shift working; 40 persons per bus. (See Map No. 80 "Autonhill—Evening Peak Traffic Flows 1966".)

The resulting flows produce acceptable waiting times at each junction and a level of traffic in the culs-de-sac which is compatible with the safety of

the small volume of pedestrian traffic which would have to cross the roads.

One garage place (usually in a garage court) and one parking space for visitors would be provided for each dwelling. The maximum carry distance from dwellings to the nearest vehicular access point would be 150 feet.

#### House Types

Average family size would be 3·5 persons and the allocation of dwellings according to size is:

		Dwellings
1 room dwellings	-	5% 135 (including OAP dwellings)
2 room dwellings	-	12% 180
3 room dwellings	-	20% 300
4 room dwellings	-	25% 375
5 room dwellings	-	22% 330
6 room dwellings	-	8% 120
7 room dwellings	-	4% 60
Total	-	100% 1,500

This distribution is comparable with an established New Town with the exception of the low percentage of two room dwellings. It is anticipated that single persons and young married couples without children are more likely to be attracted to the regional centre than to an area like Autonhill.

A wide cross section of house types is envisaged from single story patio houses to four storey flats



Map No. 78: Antonshill—Road System

Key: 1. District distributor road. 2. Local distributor road. 3. Access road.

but the predominant type would be the two storey house, either of narrow frontage dual aspect or wide frontage single aspect depending on its orientation and location within the tight-knit groups of housing. The houses would be arranged so that public areas and play spaces could be supervised from kitchen windows.

In the past, local limitations of materials have produced visually homogeneous housing areas. In contrast the great range of building materials available today presents a great temptation to the designer. Nevertheless the range of materials used should be carefully chosen with a view to achieving a new tradition of homogeneity based on factory produced components.

#### Programming

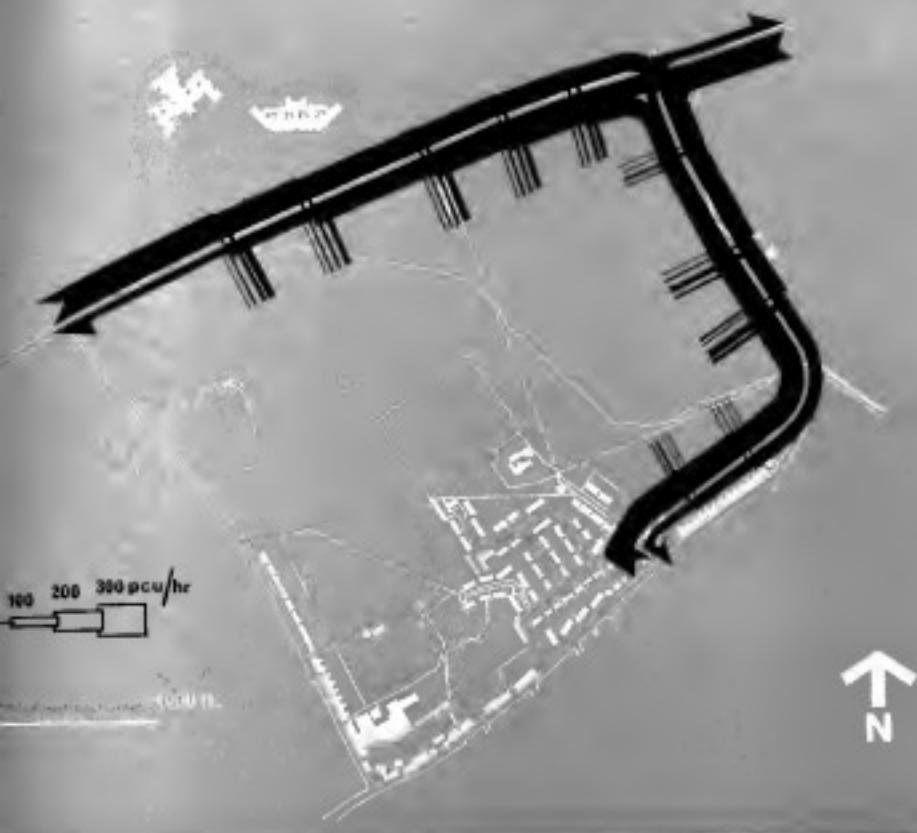
Development proposals are shown on Map No. 81 "Antonhill Environmental Area"; and apart from the availability of land their programming would largely depend on the ease of extending and exploiting the existing utility services and would proceed from the perimeter roads towards the centre of the area. For this reason development could commence in the south east quadrant of the site (the area closest to the existing development at Stenhousemuir).

A rapid construction rate will be necessary in a Growth Area (as in a New Town) and industrialised methods are likely to be the best way of achieving this. Lessons should be learned from past experience in the development of large housing areas with no provision of community facilities. Since excellent accommodation exists in the shape of farm buildings at Muirhead, these could be utilised for shops and meeting rooms at an early stage in the development. They will provide community facilities in a convenient location, both for the first stage of development and for the existing housing north of King Street and will establish early on the beginning of the pedestrian network. After the erection of new shops these buildings could be converted for use as clubrooms.

#### FALKIRK CENTRAL AREA

It is necessary to examine the present and future functions of the central area of the Burgh of Falkirk before putting forward recommendations for a physical structure together with principles and priorities for future development.

The planning concept has evolved within the context of the Growth Area Structure Plan. Specific allocations, details of design and implementation will be a matter for local decision.



Map No. 80: Antonshill—Evening Peak Traffic Flows (1988)

#### Growth Area Proposals

- 1 Falkirk Central Area should remain the major administrative and commercial centre and should expand to serve a total population of nearly 230,000 by 1985.
- 2 Gross shopping floor area would be in the vicinity of 770,000-800,000 sq. ft. This figure does not include banks, post office, car parking or commercial entertainment which in total would more than double this area. A further 100,000 sq. ft. of office space would also be needed. Employment is estimated as 3,000 persons in retail trades; 18,000 persons in services; 1,280 persons in manufacturing.
- 3 Housing should accommodate 3,500 persons.
- 4 One of the aims of the primary and district road system is to promote a level of accessibility which is satisfactory for an administrative and commercial centre. The system would include a one-way distributor road encircling and serving the central area.
- 5 Provision would be made for a system of pedestrian ways linking the central area pedestrian routes to surrounding environmental areas within twenty minutes walking distance of the core, and to the regional greenway network.

#### Present Character

The central area is at present the established and

prosperous commercial, administrative, and entertainment hub of the Area, providing a wide range of facilities for a local population of 40,000 persons, and a catchment area of approximately 70,000 persons. (See Map No. 82 "Falkirk Town Centre (1'")".)

The landform is a ridge-shaped mound, between the valley of the West Burn from Anton Hill, and the valley of the East Burn from Calendar Park. On the north the ridge slopes to the coastal plain, and on the south to a valley below the high moorlands. Major communication routes have followed the line of the contours, resulting in an east-west linear form of development along the ridge. The site is well drained and sheltered to some extent from the cold north and north-east winds by the Ochil Hills and the outcrops of the Perthshire mountains.

The area is more distinguished for the scale of its narrow historic streets than for the beauty of its architecture. The High Street, enclosed by three- to four-storey traditional Scottish buildings, is particularly attractive, curving gently, with intimate views down narrow closes, and opening out in places to long views over the Firth to the northern hills. As the Burgh is approached the spire of the Parish Church and the Steeple pin-point the centre. Several buildings are included in the Scottish Development Department's "List of Buildings of Architectural or Historic Interest", and these contribute to the town's pleasant scale and character.



*Map No. 81: Accessibility—Environmental Area*

Key: 1. Local shops. 2. Primary school. 3. Children's playground. 4. Cinema. 5. Nursery school.  
6. Local park. 7. Bus stops. 8. Secondary school. 9. Garage.

#### Need for Change

To fulfil the future role as the major administrative and commercial centre, considerable changes will be required to accommodate the increase in building and traffic generated by the proposed growth (see Map No. 83 "Falkirk Town Centre (2)"). Care must be taken to retain the existing buildings and spaces which have given Falkirk its prosperity and character. These features should be preserved and enhanced, setting the standard for the scale and design of new development.

#### Transport

The most critical factor which reduces the efficiency and pleasantness of the centre is the deterioration of the environment caused by the

motor vehicle. The major scene to which Falkirk can credit its prosperity, i.e. acceptability, is rapidly being depressed as motor vehicles pour into and through this historic Burgh, causing congestion and pedestrian/vehicular conflict.

The rationalisation of vehicular and pedestrian traffic is a critical factor in improving the efficiency and attractiveness of the area. It will be necessary at an early stage to provide adequate off-street parking spaces, and special servicing facilities for commercial premises.

Buses are a feature of the traffic congestion, 740 public service vehicles passing daily through the main streets. The re-organisation of the present road system would facilitate the redevelopment of the existing Bus Station. The provision of an additional terminus would reduce the present concentration of buses in the east at peak periods.



Map No. 82: Falkirk Town Centre (T)

Key: Existing major land uses and facilities: 1. Commercial. 2. Public buildings. 3. Industry. 4. Housing. 5. Other uses and facilities (as—open space, r—railway station, cp—car park, bs—bus station, po—post office).

Grahamston Railway Station in the north on a main line route, serving Edinburgh, Glasgow, Stirling and the north, is conveniently sited within five minutes walking distance of the core.

#### *Commercial Buildings*

(The regional shopping pattern is presented in the Chapter on "Recommendations" and in Volume One, Chapter 5).

Shopping and commercial buildings are concentrated in a compact area enclosed by Newmarket Street—Princes Street in the north, Callendar Riggs in the east, and the High Street in the south, plus a few shops extending along the principal roads converging on the centre. There are 257 establishments, excluding service trades and commercial entertainment, with a gross area of 369,780 square feet, 21 per cent of this area having been developed since

1960, including a major shopping development and hotel at the east end of High Street. The principal traders are located on both sides of busy streets carrying through traffic, making it inconvenient and dangerous for shoppers. The buildings are generally of a high standard but deterioration in the straggling development lining approach roads. Some 91,000 square feet of office space is established.

Redevelopment of existing established shops would be by minor improvements including adaptation to rear service access and gaging. Straggling development along arterial roads should be discouraged.

#### *Civic, Cultural and Entertainment Buildings*

These facilities are generally in good physical condition although dispersed throughout the town rather than concentrated in a specific zone. The



Map No. A3: Feinkwick Town Centre (2)

Key: Existing major land uses and facilities: 1. Commercial. 2. Public buildings. 3. Industry. 4. Housing. 5. Other uses and facilities (e.g.—open space, r—railway station, op—open space, br—bus station, po—post office, p—telephone). 6. Need for change. 7. 2nd and 3rd class commercial buildings. 8. Residential areas needing redevelopment. 9. Residential areas requiring improvement. 10. Areas of pedestrian/vehicle conflict. 11. Congested intersection. 12. Area of architectural and historic interest.

only example of this type of zoning which causes benefits in terms of shared services is the area to the west, including the Public Library, the Theatre, the Police Headquarters and the Municipal Buildings. Further west is Dollar Park, which houses the town's small museum.

In most cases these buildings can expand within their present sites. Future facilities of this nature would be better related to the core of the centre, enhancing its character, creating activity after shopping hours and reaping the economic benefits of more functional grouping.

#### Housing

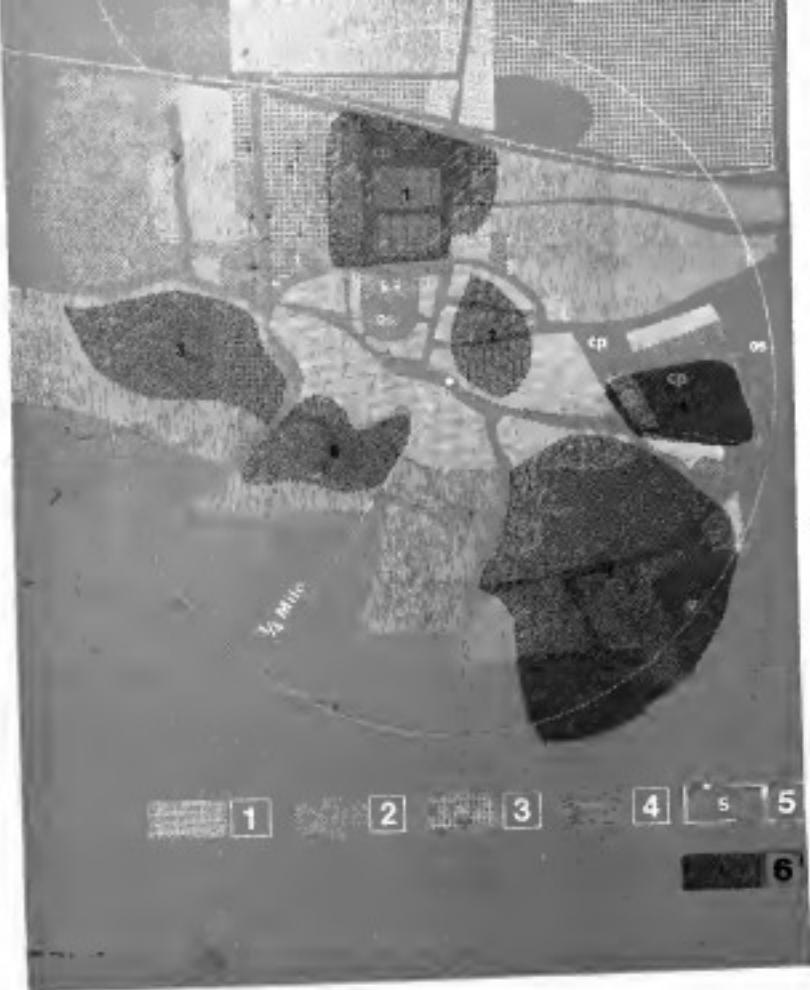
Several areas of housing require redevelopment, and some larger areas require improvement. The former are generally four-storey terraces built during the industrial boom at the end of the nine-

teenth century; the latter are classified as being in first class condition<sup>(2)</sup> with a life of over 30 years. Improvement in the layouts could be achieved by modest reorganisation of roads, the provision of garaging, parking spaces, planting and play areas.

#### Industry

There are two major manufacturing industries. The larger is Adlib Brewery, a branch of Caledonian Breweries, in a site of 3-25 acres. Established in 1700, it no longer relies on the site's special characteristics of water supply and sand access. The Ardswood Water Works on a smaller site to the south west is in second class condition<sup>(3)</sup>. These industries are considered non-conforming in an expanding regional centre, and their removal would release land well-located for central area expansion.

(2) Department of Health for Scotland, Town and Country Planning Technical Handbook.



**Map No. 84: Falkirk Town Centre (3)**

**Key:** Existing major land uses and facilities: 1. Commercial. 2. Public buildings. 3. Industry. 4. Housing. 5. Other uses and facilities (so—open space, r—railway station, b—bus station, cp—car park, bg—bus garage, pc—parish church, a—allotments). Opportunity for change. 6. Areas where opportunity for change occurs.

#### Recreation

Of the range of sports facilities available, only the swimming pool is obsolescent and should be replaced. The remaining provisions are in first class condition<sup>(1)</sup>, conveniently sited on the periphery.

#### Opportunity for Change

The future role of the central area presents the necessity and opportunity for large scale comprehensive redevelopment. Several areas of struggling and obsolete buildings, together with vacant sites and areas designated for redevelopment by the Burgh, release approximately 40 acres for the expansion of established and flourishing uses as well as for the provision of new uses. (See Map No. 84 "Falkirk Town Centre (3)".)

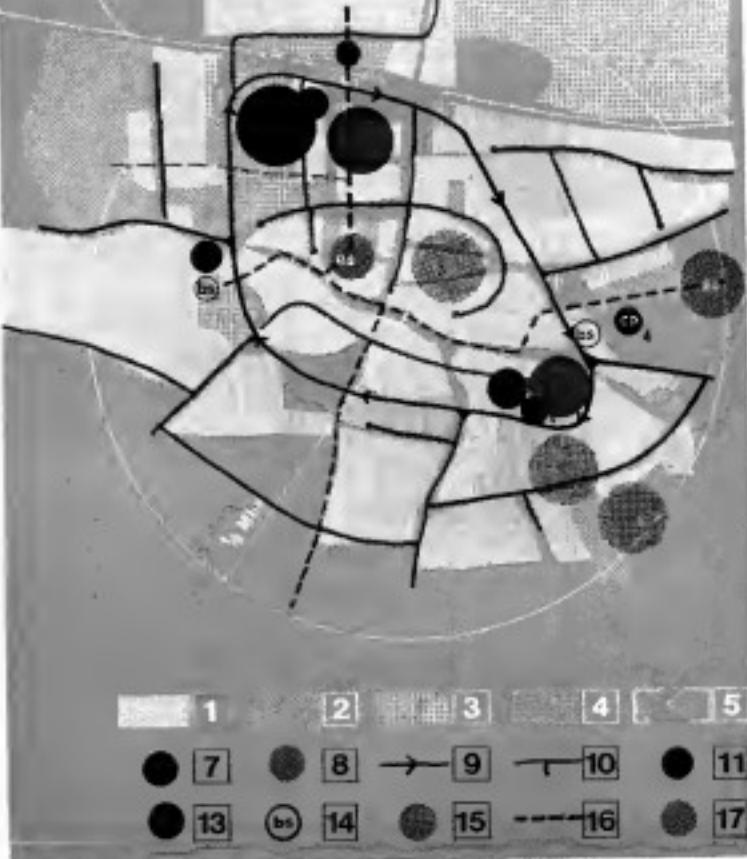
There are six major areas suitable for comprehensive redevelopment: the Garrison area in the

north; the Manor Street area in the centre; the West Bridge Street area in the west; the Bus Station area in the east; the Williamson Street area in the south-east; and the Howgate area in the south.

Additional redevelopment is likely to be piecemeal rather than comprehensive, the established use pattern being improved by the introduction of service bays, garaging, etc., to improve the functioning of the existing predominant use.

A survey of premises at present serviced from the High Street was carried out by the Burgh in 1965. With the exception of some older properties contained at the rear by the grounds of the Parish Church, properties can adapt easily to a system of rear servicing, facilitating the Burgh's proposals for the removal of traffic from a street with a character and scale admirably suited for a traffic-free precinct.

(1) Department of Health for Scotland, Town and Country Planning Technical Handbook.



**Map No. 85: Falkirk Town Centre (4)**

**Key:** Existing major land uses and facilities: 1. Commercial. 2. Public buildings. 3. Industry. 4. Housing. 5. Other uses and facilities (or—open space, r—railway station, cp—car park, bs—bus station, pc—parish church, s—sttlement). The Planning Concept: 7. Future offices. 8. Future cultural and entertainment buildings. 9. Ring road. 10. Service road. 11. Car park. 12. Future shopping. 13. Bus station. 14. Open space. 15. Pedestrian system. 17. Housing.

#### The Planning Concept

The natural land form of the valleys in the south and west, together with the physical barrier of the railway line in the north, impose thresholds for expansion. Historically, these characteristics have encouraged a compact form of development. Map No. 85 "Falkirk Town Centre (4)" illustrates proposals retaining and exploring this feature, creating a relatively high density compact centre approximately half a mile in diameter, or ten minutes walking time.

Access of private vehicles into the central district would be limited and the historic core converted to a traffic free precinct. Vehicles would be distributed to the various zones by a one-way ring road closely associated with parking facilities.

An alternative solution allowing free access of

private vehicles into the centre was rejected. The demolition and redevelopment necessary to allow access for the very large volumes of traffic would not only be costly, but could completely destroy the scale and charm of this district of the historic Burgh.

Areas selected for comprehensive development to accommodate expansion include:

- 1 the area south of Grahamston Station;
- 2 the area south east of High Street;
- 3 the area north of the Steeple;
- 4 the area east of the existing Bus Station.

Area 1 should be developed primarily for shopping and offices, including the new G.P.O. Pedestrian linkage with Grahamston Station to the north, and existing offices and community facilities in the west could be provided simply. Car parking, service

roads, and bays should be designed as integral elements of the buildings, closely associated with the one-way distributor road. The form of development should be no more than four storeys, stepping down the contours from Newmarket Street in the south to the railway station in the north. This would ensure a compact development in scale with the historic buildings to the south, while permitting the Steeple, and the spire of the Parish Church to remain the dominant vertical features of the Burgh. Pedestrian links north and south could exploit the steep gradients making possible an upper level pedestrian system (see Diagram No. X).

Area 2 should be developed for shopping, housing and offices. Shopping would form an extension of existing facilities in the High Street and Callendar Riggs. Housing on the south-facing slopes should be related to the existing residential development to the south and the recently completed high buildings in Callendar Park Estate in the west. These areas are within five minutes walking distance of the central area and the regional public transport termini. The form of development should be similar to Area 1, but restricted in height to two to three storeys in the north to preserve the scale of the High Street (see Diagram No. X).

Area 3 should be developed primarily for cultural and entertainment buildings. The opportunity exists to create a civic square integrating the historic Steeple (the existing focus of the Burgh) and opening directly to the High Street. This area is in close proximity to public transport terminal and could utilise commercial car parks which are vacated in the evenings.

Area 4 would be dominated by the redevelopment of the bus station. Commercial entertainment with ancillary restaurants may be appropriate, but in the near future this area should provide the major source of surface car parking for the central area.

The existing Public Park to the west should be retained in its present use, providing a restful

sheltered open space, closely associated with the centre.

The redevelopment areas would be linked by the one-way distributor ring road considered as an integral element of the new building development. Service access to existing buildings would mainly utilise existing streets.

Kirk Wynd, Princess Street and Newmarket Street would form the major framework from which branch loop roads or culs-de-sac. Shops on the south side of High Street would be serviced at the rear by a new road forming a loop from the ring road.

Public car parks would be sited within two to three minutes walking distance of the principal traffic generating areas. Sites selected would generally be available for surface car parks at an early stage in the implementation of the road system. When additional space is required, parking could be in multi-level structures on the same sites.

The location of new facilities would create major pedestrian flows to exploit further the historic features of the High Street, and the grounds of the Parish Church. Pedestrians entering the centre from parking areas and Public Transport termini on the periphery (including the additional bus terminals in the west) would converge historic pedestrian alleys, whose scale and character should set the pattern for new development incorporating pedestrian areas. The land form in many places would permit vertical segregation of pedestrians and vehicles, linking new development with old.

#### Programming

From this study it can be seen that change may take place in two ways: by improvement of the existing environment, and by redevelopment. The timing of these proposals will have an important influence on their successful implementation, but detailed programming of development will be dependent not only on local conditions such as

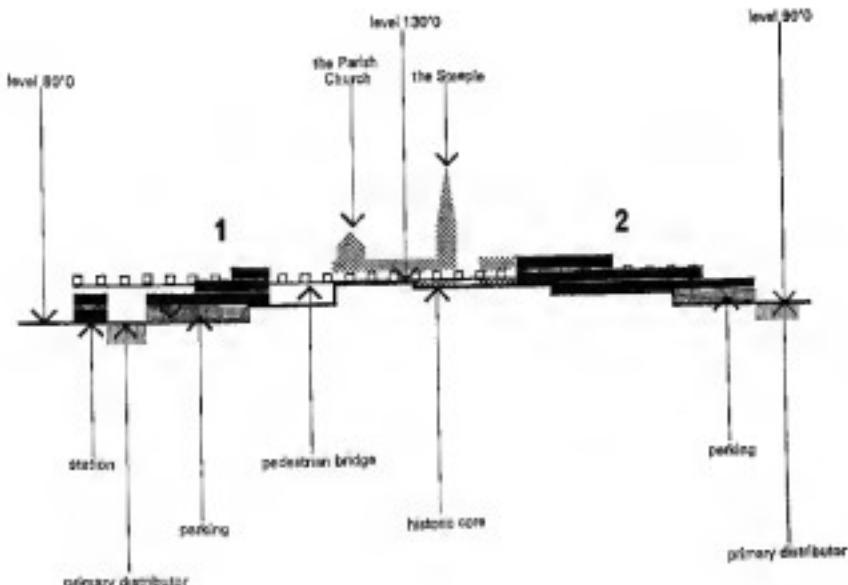


Diagram X: Falkirk Town Centre (5)

convenience of property acquisition but also on the timing of regional scale proposals such as in the construction of the primary distributor road network. Since in this document only a general framework for implementation can be outlined, the most important aspect will be to determine the optimum sequence of priorities for change. The order of priority for the proposals outlined would be as follows:

- 1 The removal of through-traffic from the High Street by the provision of the southern portion of the one-way ring road.
- 2 The provision of adequate off street parking closely associated with the southern portion of the one-way ring road.
- 3 The provision of use servicing facilities to premises in the High Street.
- 4 The conversion of the High Street into a traffic-free shopping precinct.
- 5 The provision of the additional bus terminals and associated parking.
- 6 The redevelopment of Area 2.
- 7 The redevelopment of Areas 1, and the completion of the one-way ring road.
- 8 The redevelopment of Area 4 (realised in earlier phases as the major source of surface car parking).
- 9 The redevelopment of Area 3.

Sketch No. 66 (a)—Falkirk Town Centre  
Looking into the Grounds of the Parish Church from Kirk Wynd.





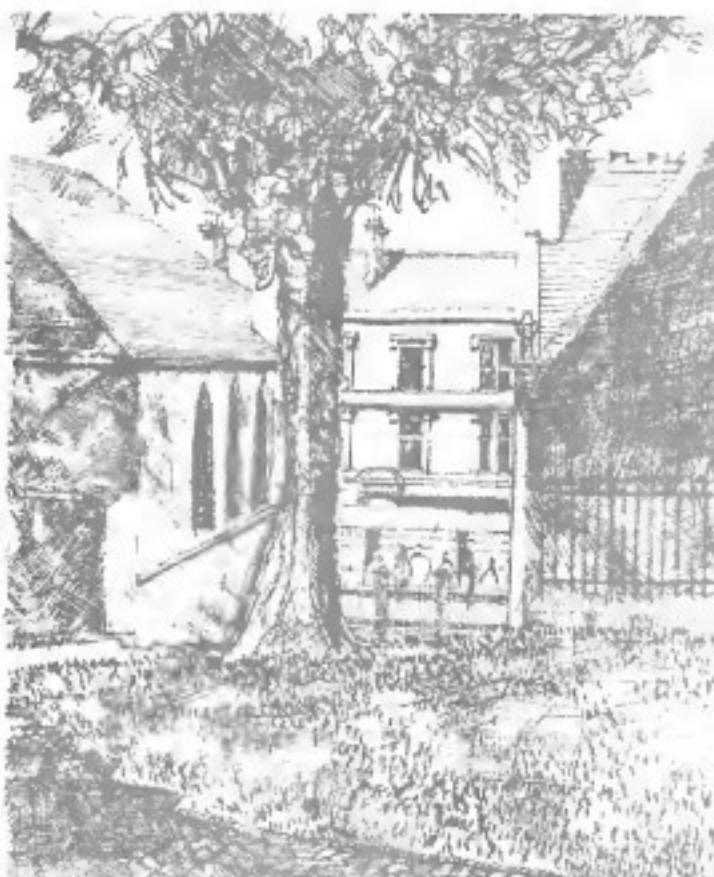
Sketch No. 88 (b)—Falkirk Town Centre  
The grounds of the Parish Church from the street.

Sketch No. 88 (c)—Falkirk Town Centre  
The grounds of the Parish Church





Sketch No. 86 (d)—Falkirk Town Centre  
Approaching High Street from the East.



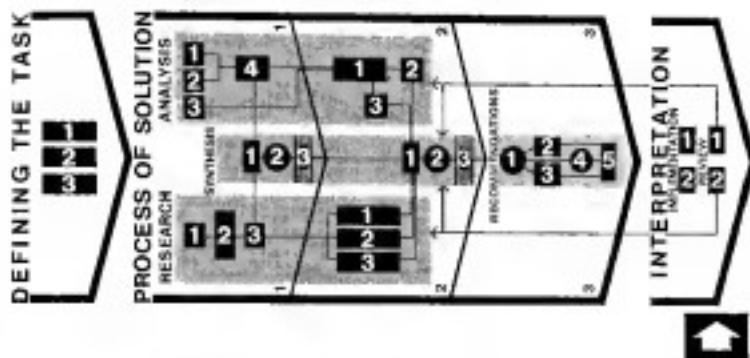
Sketch No. 86 (a)—  
Looking out from the grounds of the  
Parish Church to New Market Street.

*Sketch No. 86 (f)—Falkirk Town Centre  
The Steeple*





# Interpretation of Recommendations



## Provisions for Continuous Review

### 1. OPPORTUNITIES AND APPROACH

ASPECTS FOR REVIEW: Possible alterations to industrial trends—possible modifications of immigration rates—possible changes of internal urban structure

### 2. INDICATIONS FOR FURTHER RESEARCH

TWO DIRECTIONS FOR RESEARCH PRIORITIES: Costs assessment—transportation—environmental assessment—relocation

Following recent planning research and practice it has become widely recognised that the static form of plan is no longer acceptable. Therefore a brief note has been presented on the problems of continuous planning review with some indications for further research studies.

It would not be possible to investigate and note all cases for future review and research. Some of the more important aspects have been presented, thus showing the way of approach to this complex problem which would be of help in investigating points concerned with Plan's verification.



# Provisions for Continuous Review

## 1. Opportunities and Approach

All planning solutions must be continuously verified, indeed the periodic review of plans has statutory recognition. There are two main fields in which this process can proceed. The first involves the continuous refinement of studies undertaken during the planning process in the light of more detailed local analysis or the results from further research into planning methods and techniques. The second critical field involves the confrontation of the Plan with the reality of a changing situation during the process of implementation. Even the best plan cannot be regarded as unchangeable—it must be periodically revised and adjusted to the changing human needs and to the changing economic possibilities of the community. Planning, therefore, cannot be treated as static, since it is a conscious process in time.

Whilst it is impossible to predict all the changes which may occur or new information which may be revealed, some situations which would have an important effect on the Plan and Urbanisation Policies can be suggested. The resulting modifications would primarily be brought about by changes in the main assumptions on which the plan was based.

### Possible Alterations to Industrial Trends

The number of industries to be located in the Area may be altered due to changes in regional or national economic policies. Should this occur on a substantial scale it would be necessary to reconsider the theoretical basis of the Structure Plan arising out of analysis of the three main development models (see Phase One: "Research Studies"), because the balance of land uses and movements would be affected. On the other hand, information revealed by the Data and Analytical Studies would be still valid and only require bringing up-to-date.

It should be emphasised that this type of alteration (affecting the main assumptions on which the Structure Plan was based) could only be introduced in the early phases of implementation. These is a limited period certainly not exceeding 10 years (assuming phasing as proposed), after which the degree of flexibility in the field of industrial policy will be limited by the implemented urban structure.

### Possible Modifications of Immigration Rates

The Plan was based on the target population figures taken from the White Paper and, although

they are unlikely to alter substantially, such an eventuality should be considered. There are two possibilities: a rise in the immigration rates or a fall in the emigration rates. The first would affect the basis on which the Structure Plan was formulated. If this should occur the process of Review must commence from the very beginning, i.e., from re-examining various urban patterns for the Area. The margin of flexibility for this type of modification would be narrow, especially with regard to the time factor. Therefore, the later date at which any population re-assessment leading to a significant rise of the target figure could be made is immediately after the completion of the first phase of implementation, i.e., about 1971. In the second case, a fall in the population target would not affect the Structure Plan but rather the phasing of development.

### Possible Changes of Internal Urban Structure

Increased demands for better shopping facilities and cultural or recreational facilities could result if the standard of living rises faster than anticipated. The development of these functions may speed up to such an extent that the standards applied today for 1986 may eventually appear to be quite inadequate. If this happens, district scale centres would then probably expand at a much faster rate than predicted and might in many cases approach the size of the main centre at Falkirk. In such an event, the urban structure would no longer have the same emphasis with Falkirk as the main centre, although the shopping there ought become more specialised and still serve a wide area. District centres would increase their influences and bring about a more even spread of traffic.

The possibility of having to make major internal changes would exist for a long period, but this need not create any threat to the overall urban structure and its implementation along the recommended lines. It indicates, however, that inflexible designs should be avoided, particularly in central areas. Allowances should be made for further expansion of all shopping centres, not only to meet the needs of the expected population increase but also to accommodate possible changes in the character and the type of facilities.

The modifications so far discussed have been quantitative and do not cover technological advances in other fields which may produce changes of a qualitative nature. These would be of a more complex character and more difficult to predict.

## 2. Indications for Further Research

To complete the report it is important to indicate where further studies should be undertaken in order to adjust decisions both during Implementation and Review. These studies could be continued in two general directions.

The first towards the refinement and reassessment of the planning recommendations in the light of both local and regional investigations.

The second towards analysing possible developments in techniques and methods which might be applied to the Area.

It will be useful therefore to indicate in the light of experience gained in the planning process where the priorities should lie for further research. Four fields seem to be of particular importance. These are not necessarily the only studies which should be carried out for the Grangemouth/Falkirk Growth Areas during the next few years, but bearing in mind the enormous task facing planners in Scotland the number of studies will consequently be restricted in scope.

### Costs

It would be valuable if total development costs up to 1986 could be established. This would help to define more precisely the degree of importance of threshold costs for several areas and would allow further analyses to be carried out so that the proposals made up to now could be modified or adjusted. Some analyses of running costs are also important and should be carried out. The impact of this on decision making could be considerable.

### Transportation

The recommendations establish a strategic road plan which should be subject to continuous detailed

local investigations. To facilitate this the proposed road network has a degree of flexibility which would allow for modifications in road alignments or of the urban structure, and could cope with traffic loads generated by an increase of 25 per cent of the target population. Further studies should proceed in close collaboration with the consultants appointed to undertake the Greater Edinburgh (Firth Valley) Transportation Study to allow investigations of the traffic problems over a wide area.

### Environment

The criteria used to assess the quality of the residential environment were as objective as possible but could be refined by mathematical quantification. Studies have already been published relating to particular aspects of the environment in isolation (e.g., noise, traffic generation, climate, etc.), but a set of related standards is required embracing all environmental criteria. These could be used as a precise yardstick to measure particular developments. Perceptual influences would be harder to quantify but research is being undertaken in this field at present and is worth proceeding in relation to these other factors.

### Reclamation

The challenge presented by the Strathclyde Plan to land improvers is one which would probably take decades to meet. A preliminary programme of research has already been included in the Proposals, but in view of the rate of scientific research throughout the world, it would be advisable to maintain a watching brief to take advantage of any relevant developments. The Department of Agriculture would also be involved in any major rehabilitation scheme and research.

## **Appendices**

- 1. DRIFT GEOLOGY IN RELATION TO FOUNDATIONS**
- 2. ASSESSMENT OF URBAN AREAS**
- 3. EDUCATION**
- 4. STUDY OF PROTECTIVE ZONES FOR NOXIOUS INDUSTRY**
- 5. REHABILITATION AREAS**
- 6. ANALYSIS OF RANDOM SAMPLE OF MUNICIPAL COMPOST AFTER MATURING IN WINDROWS FOR THREE MONTHS**
- 7. HISTORIC AND ARCHITECTURAL INTERESTS**



## Appendix 1

### DRIFT GEOLOGY IN RELATION TO FOUNDATIONS

by DR. ERIC SITSONE, M.A., F.R.N.S., Advisor on Geomorphology

The purpose of this report is to describe the drift geology of the Grangemouth/Palkirk Growth Area in relation to the foundations of buildings, roads and other proposed structures. For considerable parts of this Area much information is available from geological mapping and borehole records and this material is collated and presented to map form. For some other parts of the Growth Area the information is less adequate, but is often sufficient for making useful generalisations. Since the drift geology of the Growth Area is complex and in places the drift deposits are several hundred feet thick, these generalisations are very relevant in planning the development of the Area. On the other hand, it should be emphasised that the purpose of this report is to present generalisations (it is clearly impossible to list and discuss the two thousand or so borehole records used in preparation of the Map) and that, where information for a particular site is required, borehole investigations should be undertaken in the normal manner.

#### Drift Geology

The Map Drift Geology (see Map No. 10—"Drift Geology") shows the surface geology of the Growth Area. It is based on mapping carried out by the Geological Survey, on borehole data, and (especially in the ground below about 200 ft. O.D.) on mapping carried out by Dr. Sitson. The total thickness of drift deposits of all types (i.e. drift to bedrock) is also shown at various points on the Map where sufficient data are available. These figures are selected as representative of the drift thickness of the locality at which they are marked but records of unusually thick drift are also given on the Map. These figures are not shown on the low ground below 50 ft. O.D. since data are here sufficient to allow construction of a separate simple Map of the thickness of soft surface deposits.

On the map, Drift Geology, the ground above 650 ft. O.D. is not considered owing to its altitude. The remainder of the area on the Map may be considered in turn.

**Rock:** Rock comes to the surface over only small parts of the Growth Area. In these surface outcrops it is usually igneous, sandstone or limestone and hence provides a very strong foundation. On the other hand, the laying of pipes, levelling of roads, etc. will be more costly than in softer materials. Furthermore, the rock outcrops often form rough, irregular terrain and slopes are locally steep (e.g. river gorges and rocky hills). The areas marked "Rock" thus present considerable disadvantages.

**Boulder Clay:** This deposit is typically a tough accumulation of clay and stones of all sizes mixed with some sand. It forms a sheet of variable thickness overlying the rock. Over the large belt of country south of Falkirk and Bonnybridge to the southern limit of the Growth Area, on the hill slopes north-west from Larbert, and in the higher parts of Bo'ness and adjacent ground as far as the River Avon, the boulder clay is usually between five and twenty or thirty feet thick. Elsewhere its thickness is much more variable and it is in places mixed with beds of sand and gravel.

Since the boulder clay has usually been greatly consolidated by the weight of the ice sheet that deposited it, it normally provides a very strong foundation, although excavation may be hampered

by the toughness of the material and the presence of occasional large boulders. However, the surface layer is usually weathered to a weaker material while, in addition, over large areas the typical tough boulder clay is overlain by a much looser deposit. This surface deposit, best described as sandy clay with stones, is typically a few feet thick (although it may reach ten feet and, rarely, twenty feet). The safe bearing capacity of this surface deposit is variable but a representative figure may be of the order of 1½ tons a square foot.

The boulder clay areas are thus very suitable for building so far as geological factors are concerned for, apart from often being associated with smooth gentle or moderate slopes, the rather loose surface deposit that is often present facilitates excavation, while the boulder clay itself normally provides a very strong foundation.

**Sand and Gravel:** The boulder clay normally underlies all the other surface deposits (sands and gravels, clays, peat, etc.) although locally it may be missing. The areas marked as sand and gravel are water-sorted deposits, often laid down by fast-flowing rivers. Hence they have little silt or clay content and consist of alternating layers of different sized materials. The proportion of sand to gravel can vary very greatly in a few tens of yards so that the character of the deposit at any particular site can be determined only by detailed examination and boring. Normally the sands and gravels rest on boulder clay and provide good foundation conditions. In the area shown as sand and gravel between Camelon and Stenhousemuir on either side of the River Carron, conditions are especially complex and, in some places at least, the sands and gravels rest on soft deposits. Soft deposits also underlie the surface sands and gravels in an area further west, extending from Larbert through Cambuslang to the old Forth and Clyde Canal, but since the surface sands and gravels here are often fifteen or more feet thick, these soft deposits need only be taken into account if very heavy structures are envisaged.

It should be added that the areas marked as sand and gravel include narrow belts of soft alluvial deposits, for example, along the course of the River Carron and Bonnywater. Similar deposits occur as narrow strips along valleys in other parts of the area but are too small to show.

**Silt, Clay and Sand:** These sediments were laid down in the sea at a time when its level was considerably above its present level. They therefore have a sharply-defined upper limit, which is 125 ft. O.D. at Pleas, 120 ft. at Larbert, 105 ft. at Polmont and 90 ft. at Blackness. These sediments change horizontally and vertically but, since these changes often take place in a regular manner, they can be briefly summarised.

In the large area of these deposits (0-100' thick) around Stenhousemuir and extending to Kincardine House and past Glenavon, their lower part comprises layers of laminated silt clay with very thin laminae of fine sand. The proportion of sand increases upwards, the deposit becoming dominantly sandy in the top ten or twenty feet and almost entirely sand for the top few feet. Towards Larbert and also to the south of the Carron, through Cambuslang to Falkirk, sand is more abundant and may comprise the top forty or fifty feet. A few thin layers of laminated clay occur in the sand and thicker silt-clay

with fine sand laminae underlies the thick sand layer in places. North of the centre of Falkirk the laminated silt clay with fine sand layers seems to prevail, and east of Falkirk to the border of the Growth Area at Blackness, the deposits of silt, clay and sand are composed almost entirely of this material (apart from the top few feet which in places are composed of sand).

Where the bearing capacity of these deposits has been determined by various Consultants, the recommended safe loading in the laminated silt clay area (with or without a thin surface cover of sand) usually lies in the range fifteen to twenty-five tons a square foot. It may be expected that where the surface sand is thicker, the bearing capacity will be higher.

One point to which attention should be drawn is that the front of these deposits where they overlook the low ground of the Carron have been eroded to form a steep bluff in some places. In such places the front of the deposit (at one point known to be seventy ft. thick) is unbroken. Hence it would seem advisable to investigate the possibility of flowage of these deposits if the creation of heavy structures near their edge is envisaged. The same possibility should be considered where large buildings are proposed near the edges of the various deep pullings that intersect the otherwise flatish surface of these deposits.

**Silt, Clay and Water:** The low, almost flat, ground below 50 ft. O.D. is surfaced by a deposit of very uniform character almost throughout. This deposit, commonly called Carron clay, is composed of silt and clay, sometimes with a little sand. It was accumulated in strandlines in the old estuary of the Forth and has since been elevated above sea level (or, in the lowest parts, reclaimed by man). The deposit nowhere exceeds forty-two ft. O.D. and its upper limit around Grangemouth is normally between fifteen and thirty ft. O.D.

The top few feet of this deposit has been dried through exposure to the atmosphere and by artificial drainage, and forms a stronger layer than the material beneath. This Carron crust, as it may be called, appears to vary in thickness between about three and six feet, apparently attaining its greatest thickness near the deepest ditches. Beneath the crust the material is extremely soft and has a water content that is commonly between twenty per cent and fifty per cent. The bearing capacity of this soft subsurface deposit, sometimes of the nature of liquid mud, is extremely low.

Because of these conditions, buildings on the carselands fall into two main categories those resting on the Carron crust and those in which special foundations such as piles are used. The foundation conditions in relation to piling are considered in Map No. 87 showing depth of drift deposits. Here it may be noted that many tests on the bearing capacity of the Carron crust have been carried out by various Consultants and have given almost consistent results. Their tests indicate that a recommended safe loading for the carselands is between six and twelve tons a square foot. This figure is based on the assumption that the load is evenly spread; that the foundations do not pierce the Carron crust; and that where a building comprises units of different heights, these are constructed to permit differential movement. Even with the recommended loading, some subsidence of buildings will take place. However, it should be made clear that, contrary to pessimistic views sometimes expressed, building on the carselands need not present difficulties if proper precautions are adopted. Grangemouth, in fact, is built entirely on these deposits.

**Peat:** The peat on the higher ground in the south and west of the Growth Area generally occupies

shallow basins with gently-sloping sides. The two large areas of peat lying on the carselands (Dundas Moss and Letham Moss) are different, however, in that they rest on the Carron clay while almost flat surface, beneath these mosses, is between thirty-six and forty ft. O.D. Where not partially removed or drained, the peat in these two mosses is usually between ten and fifteen feet thick. The Carron clay beneath is very soft throughout, for the Carron crust has not been able to form.

#### Depth of Drift Deposits

The Map No. 87 ("Thickness of Soft Deposits above Boulder Clay, Gravel or Rock") shows the thickness of soft deposits overlying boulder clay, gravel or rock in the area of the carselands, extending from a point roughly midway between Boness and Grangemouth to the vicinity of Airth. The Map enables the length of piles that would be required in a particular area to be calculated, within the limitations imposed by data so far available.

The Map is clearly entirely dependent on the borehole data. For this reason the sites of all boreholes used in its construction are marked. These boreholes are numerous, therefore, the lines showing the thickness of soft deposits should be accurate within the limitations imposed by the borehole records themselves. On the other hand, where boreholes are widely scattered, the lines are less satisfactory and in some places clearly sensitive. The borehole records have been supplied by the Geological Survey and by many firms and Local Authorities. In general borehole records from the many different sources show a high degree of consistency. A few records that are suspect or known to be inaccurate have been rejected.

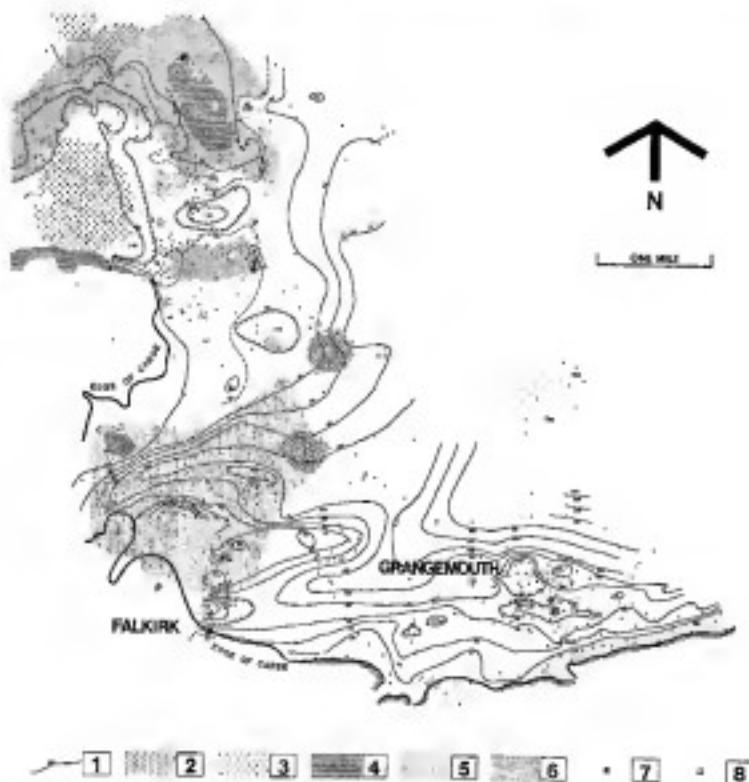
Over most of the Area, the sequence of deposits is as follows:

- 5 Carron clay, with some layers of sand and shells
- 4 Gravel and sand
- 3 Laminated silt and clay with thin layers of fine sand
- 2 Boulder clay
- 1 Rock,

The usual relations of these deposits to one another can be described thus: the gravel and sand layer (No. 4) beneath the Carron clay is a widespread deposit, typically two to five feet thick, and sloping very regularly seawards, from about or slightly above Ordnance Datum at its inland margin near the bluff that bounds the carselands, to about twenty feet below O.D. in the northern part of the Grangemouth oil refinery site. The laminated deposits (No. 3) are a continuation of the fine drift deposits shown as silt clay and sand on the Map "Drift Geology", and have the same characteristics. The boulder clay (No. 2) is of rather widespread occurrence and is often many tens of feet thick. The depth at which boulder clay is encountered varies considerably, for it has a strongly undulating top surface. In certain areas the boulder clay is missing.

Many piles have been driven for the foundations of large structures in the Grangemouth area and the low ground of Falkirk. Almost all of them terminate in the boulder clay, a few others reaching gravel or rock. In terms of the sketch this means that the piles are founded in or on beds 1 or 2 while beds 3, 4 and 5 may be grouped together as soft deposits. Map No. 87, "Thickness of Soft Deposits above Boulder clay, Gravel or Rock", therefore shows by implication the thickness of beds 3, 4 and 5 taken together.

In the Grangemouth area most of the piles penetrate the boulder clay for ten to twenty feet



Map No. 87: Thickness of Soft Deposits above Boulder Clay, Gravel or Rock

Key: 1. Thickness of soft deposits in feet. 2. Area where boulder clay or gravel underlie by softer deposits. 3. Areas of surface peat. 4. Rock, gravel or boulder clay at surface. 5. Areas where rock immediately underlies the soft deposits. 6. Areas where upper part of boulder clay is soft. 7. Boreholes to boulder clay, gravel or rock. 8. Boreholes abandoned in soft deposits.

Therefore, over most of the area covered by Map No. 87, the approximate length of pile likely to be required at a particular point is obtained by adding ten to twenty feet to the thickness of soft deposits as given by the isopleths. There are, however, certain locations where this simple rule does not apply.

In some places, as shown on the Map, rock immediately underlies the soft deposits. Here the length of pile required is given by the isopleths themselves (unless the rock is of soft shale, for example, into which piles can be driven).

In three areas the upper part of the boulder clay is recorded as "soft" in the borehole records, this soft boulder clay sometimes being stated to be forty feet thick. The isopleths show the thickness of deposits above the boulder clay, so that in these three areas allowance must be made for this extra forty feet or so of soft material. It should be noted also that the extent of these three areas is very uncertain since most of the boreholes in the vicinity of their occurrence are old ones concerned only incidentally with recording the nature of the drift deposits. It is quite possible that all three areas form part of one larger area. In other words, in this region piles might have to be much longer than the isopleths shown on Map No. 87.

A slight complication is introduced in some places, where softer deposits underlie the boulder clay.

These underlying deposits are usually bedded sands and may be fifty feet thick. Since the overlying boulder clay is often thick (ten or more feet) and the sands themselves are unlikely to suffer much compaction, these areas should not normally present difficulties in this respect and are merely shown as additional information.

A further point that must be mentioned is the intermittent occurrence of a bed of peat, usually a few inches to a foot thick (but very occasionally two to three feet thick) immediately underlying the Caen clay. It is very unlikely that this peat will be encountered east of a north-south line midway between grid lines 90E and 91E, excepting only a narrow strip very close to the southern margin of the coredlands. Even in the area where it may be encountered, this buried peat layer has a very patchy occurrence.

Reference must also be made to the rather complex pattern of isopleths shown in the vicinity of grid line 90E around its intersection with 81N. The sequence of deposits appears to be complex in this area and the recorded thickness of the soft deposits varies rapidly over short distances. The isopleths shown in this area are therefore very tentative.

It is not necessary to discuss the implications of the thickness of soft deposits in detail since they are evident from the Map in the light of the preceding

explanation. It may be pointed out, however, that in terms of piled foundations for heavy buildings (and, of course, many other factors have to be taken into account), the least favourable areas (owing to considerable thickness of soft deposits) are two west-east belts: one approximately following the course of the River Carron; and the other running from the eastern outskirts of Falkirk through the centre of Grangemouth to the northern part of the oil refinery site and the dock area (where over two hundred ft. of soft deposits occur). On the other hand, in a north-south belt over half a mile wide and three miles long extending from the northern margin of the Growth Area through Airth and thence to the vicinity of the Carron Valley, the flat carseland is underlain by only a limited depth of soft deposits (excepting for one small area). In this north-south belt piles would rarely have to exceed fifty feet in length; could be as little as twenty feet long over a considerable area; and in some places could be dispensed with altogether as foundations could be laid on the rock underlying the flat carseland.

#### Planning implications

On areas of stiff boulder clay, the bearing capacity is extremely high and should support the heaviest structures.

Where the boulder clay surface has weathered to a

thin soil layer, the bearing capacity of this top layer may be about thirty cwt.s per square foot.

The areas of sand and gravel are usually underlain by boulder clay and should provide good foundation conditions. Where they rest on soft deposits, very heavy structures may not be supported.

On the areas of silt, clay and sand the safe loading lies between fifteen and twenty-five cwt.s per square foot. Where the surface sand is thicker, the bearing capacity should be higher.

Special precautions should be taken at the edge of the cliff, bounding the silt-clay-sand area to investigate the possibility of "flowage" if heavy structures are considered.

On the Carron clay areas the recommended safe loading is between six and twelve cwt.s per square foot. This is based on the assumption that the load is suitably spread, and that the crust is not broken.

The depth of peat at Denny and Leitham is usually ten and fifteen feet thick, and the Carse clay beneath is very soft, making their development more difficult.

For heavy structures requiring piles in the Carse areas, the least favourable areas are in two belts; one approximately following the course of the River Carron; and the other running from the eastern outskirts of Falkirk through the centre of Grangemouth to the dock area. The most favourable area extends from the northern margin of the Growth Area through Airth towards the Carron Valley.

## Appendix 2

### ENVIRONMENTAL ASSESSMENT OF URBAN AREAS

#### Falkirk

Environmental rating was closely associated with age. Where older buildings were generally more predominant and bordered on, or were adjacent to primary traffic routes, they were rated poor.

A twilight zone of poor areas was generally found round shopping centres since, though in many cases the shops have been renovated, the neighbouring housing remains in a state of neglect. Examples were found in areas bordering Falkirk's major centre and those of Camelon, Grangemouth and Bainsford. Most of Grangemouth, the largest of these local centres, may be designated as a clearance area. All three areas suffer because of locations on busy through-traffic routes.

All housing within a boundary line drawn round Falkirk's central commercial area was rated poor.

Areas rated fair were generally found bordering the twilight areas. In most cases these could be improved by closing certain streets to through-traffic, by providing children's play areas at the end of the culs-de-sac (which would then emerge) and by planting. In general, upgrading would be difficult to provide adjacent to the houses, but existing play areas which are badly sited and without adequate facilities might be adapted to fulfil this need. The most suitable areas for improvement are at Carronbank, Bainsford (around Marion Street), and in Grangemouth. Hayfield in the Bainsford area is a relatively new suburb surrounded by heavy industry and is rated fair.

Most of the housing areas were rated fair plus. These are generally never developed.

The larger areas of higher ratings were found in South Falkirk, which contains middle-income housing built since 1930, and some pleasant larger houses in extensive well-wooded grounds such as those at Arnoshill. These were rated good. There

are also a number of small pockets of good environment, the most noteworthy being the recently developed area south of Camelon public park.

No areas were rated very good.

#### Grangemouth

(Note: this section is in the main body of the Report: "Land Uses and Environment".)

#### Bo'ness

Environmental ratings were closely related to the age of layout; the oldest areas having the lowest rating, except where areas front a busy traffic route or lie adjacent to noxious land uses, when more modern development was also given a low rating. Older dwellings adjacent to open space with a good outlook and/or where part of a spacious layout, were given a higher rating.

The existing centre where it lay along the main traffic route or adjacent to the docks was rated mostly poor. Most layouts had meagre space round the buildings with no gardens and little access to private or public open space. The main shopping street rated fair since traffic there is comparatively light.

The Castle Loan area was rated fair, but this could only be improved to a satisfactory extent by closing both streets to traffic. Rear access might be possible since the back gardens are extensive.

Dean Road provides a fast traffic route east-west through the town and is likely to become an important spine route past the proposed Douglas Park shopping centre. Dwellings on this road have been mostly rated fair. Unless traffic volumes are reduced or screening is provided, or there is access from the rear, it will be difficult to improve the environment.

Although rating for the Newtown Area was fair plus, improvement seems feasible by partially

closing some roads to establish a pattern of pedestrian routes. The area might then be linked to a proposed new residential development to the south. Standards of parking, garaging and play spaces might also be improved at the same time.

The Grangepass development was built recently and incorporates a small shopping centre; most of this area was rated GOOD. The remaining part, which has access from the main traffic route, was rated FAIR. Had the blocks been at right angles to the road and further away from the noise, fumes and danger, it would have been rated GOOD like the rest of the scheme.

No areas were rated VERY GOOD.

### Denny and Dunipace

Housing environment rated POOR was situated along main roads, most of it being old obsolete property. The largest areas with this rating were in the existing town centre where plans for redevelopment are being prepared. The remainder could only be dealt with by redevelopment and providing rear access.

Property rated FAIR is scattered in small areas all over the Burgh; some lies along the main roads and the remainder is particularly dull development, mainly built during the 1930's. The former can be dealt with only by redevelopment; the latter could be improved by providing garages and planting trees.

The largest proportion of housing in the Burgh is in the FAIR PLUS category; nearly all of it post-war development. It could be improved by provision of more garages, children's play spaces and planting.

No residential development was rated GOOD or VERY GOOD.

### Bonnybridge

Much old property along the main roads is dull and ripe for development and was rated POOR.

New council houses form a large proportion of the development and were rated FAIR PLUS, though improved amenities would help the environment considerably.

North of the Bonny Water, property on both sides of Larbert Road was rated FAIR where access was directly off the road. Most of this property is old and would be difficult to improve. Local authority housing in Highland Dykes Crescent could be improved by providing garaging and planting.

Recent housing close to the motorway had to be rated FAIR, and improvement seems possible only on the east side where there is room for planting between the dwellings and the motorway. South of the Bonny Water, older property in Princes Street and Anderson Street was rated FAIR, as did other development having access from Falkirk Road only.

No housing was rated as having GOOD or VERY GOOD environment.

### Larbert/Stenhousemuir/Carronshore

**Larbert:** Dwellings are mainly strung out along the main traffic routes A9 and Larbert-Stenhousemuir Road. Where property lies close to the traffic or adjoins noxious industry, the rating was POOR. The next rated FAIR. Areas rated FAIR PLUS were dull, and could be improved by planting and reorganisation of the road pattern. A number of dwellings overlook industry which produces smoke and dust.

**Stenhousemuir:** Most of the oldest development lies along the main traffic route, with some of the dwellings above shops, and was rated POOR. Areas

along bus routes, other traffic routes, or adjacent to railway lines rated FAIR, and these would be difficult to upgrade. Overhead cables pass through Ladyside Crescent, Breast Avenue and Stenhouse Road, creating a very unpleasant outlook. Trys Road and Johnston Avenue also rated FAIR but short term improvement by rearrangement of roads and provision of parking might be possible. Johnston Avenue and the main road area together would provide a larger area for development. A small, new layout, round a cul-de-sac (James Street) which has a short pedestrian path to open space rated GOOD. Dwellings with a frontage on Bellodyke Road only rated FAIR since this is a heavy traffic route to Kincardine Bridge, Stirling and Glasgow.

**Carron and Carronshore:** Dwellings along the traffic routes mainly rated FAIR and POOR. North Main Street had a rather dull layout and rated FAIR. A large area around Webster Avenue rated FAIR PLUS and could be further improved by providing more garaging or parking, rearrangement of roads, provision of play spaces and planting.

No areas were rated VERY GOOD.

### Laurieston/Brightons

**Laurieston:** The oldest part, rated POOR, is situated on the A9 which carries very heavy traffic. Newer development stretching on either side of the road towards the east rated FAIR where access was from the A9 only. The area north of Graham's Dyke Street has been redeveloped but was rated only FAIR PLUS, since further improvement by planting is desirable where the limits of the site are exposed to the north. The views could be exploited. Development south of James Street was rated GOOD where dwellings are situated round small greens.

**Westquarter:** Most of Westquarter is rated FAIR PLUS. It is a rambling layout, but makes an interesting use of levels. Dwellings round cul-de-sac rated GOOD, but otherwise a street frontage layout was used. Planting is extensive and mature though more efficient maintenance is required at the edge of the scheme. Open space is generous but there is insufficient garaging and off-street parking. Infilling has been done sympathetically.

**Redding:** The main street area has been redeveloped but still provides a traffic link between A9 and Redding Road, and where houses at a lower level can be overlooked, or front onto this road, they have been rated FAIR. Part of this area also adjoins the railway sidings and an industrial site. Areas adjacent to Redding Road (a main traffic route) are also rated FAIR.

**Redding Muirkhead:** Although traffic volumes along the Shielhill Road are not great, it is a fast route and on an exposed ridge. The rating was therefore FAIR for this area where micro-climate might be improved by planting. The dwellings at the cross-roads are older and the layout rated POOR. Prefabs at Fairhaven Terrace are in an exposed position and also rated POOR.

**Old Polwarth:** The older dwellings on the A9 which lie close to the traffic are rated POOR; all other dwellings on this road are rated FAIR. The pleasant, well-designed development by a Housing Association behind Polwarthbank Hotel has a partially segregated layout with full garaging on a cul-de-sac system, and good landscaping which gives very private gardens. This rated VERY GOOD. Harvey Avenue and Lyall Crescent, both designed round cul-de-sac and loop road layouts, rated GOOD.

*Polmear Station:* The main street is narrow and dwellings either front onto it or are above shops, and the traffic is heavy enough to warrant a rating of FAIR. Roberts Avenue area is a very dull development with little or no greening or landscaping, and rated FAIR.

*Brighton:* At the centre is a busy cross roads with dwellings over shops. This rated POOR. Developments along the main roads and in the older layout rated FAIR. Roads access might be rearranged as a short-term improvement.

## Appendix 3

### EDUCATION

#### Existing Schools 1965

Name of School	Roll	Official Capacity	BO'NESS RETAINED		Comments
			Site Area	Acre	
Bo'ness Academy S.S.	816	1,000	10.0	—	Inadequate playing fields. Land available is scrub for expansion.
Kinnell P.S.	483	600	8.0	—	—
Bo'ness Public P.S.	423	600	2.5	—	No playing fields. Requires modernisation.
George P.S.	515	600	2.5	—	Plot to be developed on ground available. Requires modernisation.
Bo'ness R.C. I. and P.S.	281	360	7.0	—	Own pitch, but more needed. Some pupils travel to Belhaven.
Blackness P.S.	59	n/a	n/a	—	Some pupils travel to Linlithgow.
TOTALS	2,886	3,080	30.0	—	—

Name of School	Roll	Official Capacity	FALKIRK RETAINED		Comments
			Site Area	Acre	
Falkirk High S.S.	1,037	880	19.79	—	To be extended.
Glesne High S.S.	1,339	1,670	17.56	—	To be reconstructed.
Canaline S.S. (Technical)	311	490	3.16	—	—
Woodlands S.S. (Technical)	442	500	3.07	—	—
Vivian P.S., Falkirk	636	880	1.55	—	To be reconstructed.
Bainsford P.S., Falkirk	199	250	3.16	—	To be reconstructed.
Connelly Park P.S., Falkirk	507	800	2.00	—	To be reconstructed.
Langlees P.S., Falkirk	426	650	5.70	—	—
Carmunnis P.S., Falkirk	692	800	1.95	—	To be reconstructed.
Easter Cummis P.S., Falkirk	200	335	4.60	—	Second stream to be added shortly.
Wallacestone P.S.	284	280	2.01	—	—
Westquarter P.S.	360	680	3.94	—	To be modernised.
California P.S.	94	120	1.50	—	Being reconstructed.
Shieldhill P.S.	171	210	4.00	—	—
St. Mungo's R.C. S.S. (Technical)	510	460	16.14	—	To be extended.
St. Andrew's R.C. P.S.	274	240	0.45	—	—
St. Francis R.C. P.S.	577	650	6.08	—	Takes pupils from Larbert.
TOTALS	6,731	10,145	101.57	—	—

#### TO BE ABANDONED

Leatherton P.S.	333	—	1.46	—
Polmont P.S.	66	—	0.62	—
TOTALS	399	—	2.08	—

## GRANGEMOUTH

## RETAINED

Name of School	Roll	Official Capacity	Site Area Acre	Comments
Grangemouth High S.S.	557	500	3-60	—
Moray S.S.	489	600	11-68	—
Beaconsfield P.S.	530	630	6-93	—
Dundas P.S.	594	710	6-35	—
Abbots Road P.S.	284	320	0-61	To be reconstructed.
George P.S.	901	900	2-11	To be reconstructed.
Sacred Heart R.C. P.S.	381	385	4-35	—
TOTALS	3,606	4,025	38-59	

## TO BE ABANDONED

Zetland Road P.S.	126	—	0-52	—
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## DENNY

## RETAINED

Name of School	Roll	Official Capacity	Site Area Acre	Comments
Denny High S.S.	927	800	22-62	—
Bonnybridge P.S.	356	450	4-34	—
Dennylochhead P.S.	113	280	0-38	To be reconstructed.
Denny P.S.	655	650	4-94	To be reconstructed.
Cairncross P.S.	17	80	—	—
Bankton P.S.	256	280	3-10	—
Greenhill P.S.	124	360	1-50	To be reconstructed.
St. Joseph's R.C. P.S., Bonnybridge	356	380	0-83	—
St. Patrick's R.C. P.S., Denny	452	415	4-76	—
TOTALS	3,232	3,575	44-27	

## TO BE ABANDONED (PROBABLY)

Dunipace P.S.	66	—	0-52	—
Bearshot Hill P.S., High Bonnybridge	46	—	1-00	—
TOTALS	112	—	1-52	

## LARBERT

## RETAINED

Name of School	Roll	Official Capacity	Site Area Acre	Comments
Larbert High S.S.	1,096	975	13-54	Extended site being negotiated.
Stenhousemuir P.S.	565	635	7-75	—
Airth P.S.	177	200	0-72	—
Bothkennan P.S.	56	65	0-79	—
Caron P.S.	238	275	2-16	—
Carromore P.S.	254	440	3-25	—
TOTALS	3,434	3,675	39-22	

## TO BE ABANDONED

Larbert Village P.S.	553	—	1-90	—
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GRAND TOTAL on School Roll: 21,779.

## Appendix 4

### STUDY OF PROTECTIVE ZONES FOR NOXIOUS INDUSTRIES (based on the Polish Statutory Regulations for Protective Zones)

Atmospheric pollution, noise, smells, etc., from noxious industries located in or near residential areas in the Growth Area have caused deleterious microclimatic conditions. It was considered therefore that a study, based on Polish Regulations which are briefly described below, might be usefully undertaken to improve the environment for existing and future residential development, and to ensure maximum protection from noxious influences.

#### Description of Protective Zones

Protective Zones are areas limiting land-use within a minimum given distance (dependent on the degree of noxiousness) around types of noxious industry. Their width is the minimum linear distance from any source within an industrial complex which could endanger nearby land-uses through atmospheric pollution, noise, fire, danger, etc. Extractive and other noxious industries have been divided into five classes, and the minimum Protective Zone width for each is given below:

Class I	minimum width 1000 metres
Class II	" " 500 metres
Class III	" " 300 metres
Class IV	" " 100 metres
Class V	" " 50 metres

Though most industries can be placed by type into one of these classes, there are certain exceptions

which may require alterations to the minimum width (i.e. factories for explosives). In these cases a comprehensive study of local conditions must be undertaken and any zoning alteration found necessary must have the approval of the Polish Department of Health.

#### Aims

Protective Zones have been set up to protect adjacent areas both from noxious influences of industry and from any accidents within the industrial site which may have serious repercussions beyond it. Only certain land-use activities are allowed within these Zones, i.e., fire stations, swimming pools, garages, car parks, laundries, warehouses, subsidiary premises for administrative, security and maintenance staffs of the industry concerned, canteens, first aid centres and agriculture. Zones may also be used as sites for non-noxious industries.

#### Results of Study

After detailed investigations based on the Polish Regulations, a classified list of noxious industries in the Area was prepared and is given below. For relevant Protective Zones see Map No. 89, 'Protective Zones'.

#### Noxious Industries within Growth Area, and the Minimum Protective Zone Widths

##### Class I minimum Protective Zone width 1,000 M.

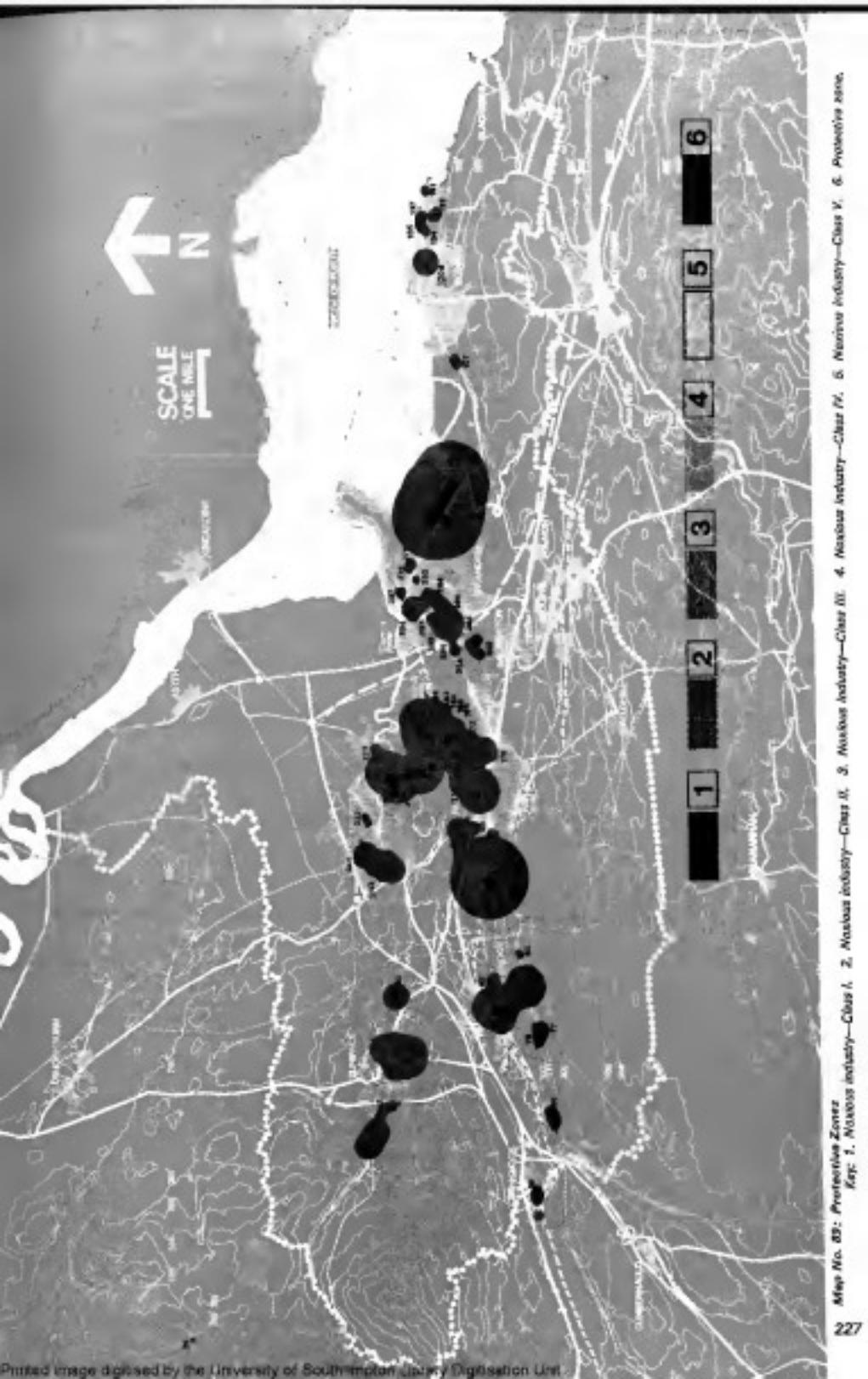
	No.	Name	Type of Industry
FALKIRK	57	Scottish Tar Distillers	Mineral Oil Refining.
GRANGEMOUTH	268	Bekelite, Xylonite Ltd.	Chemicals, Dyes, Explosives, Fireworks.
	269	British Hydrocarbon Chemicals	Chemicals, Dyes, Explosives, Fireworks.
	270	R.P. Refinery Ltd.	Mineral Oil Refining.

##### Class II minimum Protective Zone width 500 M.

	No.	Name	Type of Industry
BONNYBIDGE AND DUNSTY	34	Cruikshank & Co. Ltd.	Iron Castings.
	68	Revereble Foundry Co. Ltd.	Iron Castings.
	73	Smith and Wellwood Ltd.	Iron Castings.
FALKIRK	188	Allied Iron Founders Ltd.	Iron Castings.
	201	Mitchison Foundry	Iron Castings.
	205	Grahamston Iron Co. Ltd.	Iron Castings.
	206	Cockburn and Co. Ltd.	Iron Castings.
	216	Scottish Malt Distillers Ltd.	Other Drink Industries.
	223	Carson Co.	Iron Castings.
	234	Carson Co.	Iron Castings.

##### Class III minimum Protective Zone width 300 M.

	No.	Name	Type of Industry
BO'NESS	130a	A. Ballantine & Sons	Iron Castings.
BONNYBIDGE AND DUNSTY	1	Carrington Paper Co. Ltd.	Paper and Board.
	24	Condybank Foundry Co. Ltd.	Iron Castings.
	30	The Vale Board Mills Ltd.; John Luko & Co.	Paper and Board.
	32	George Paul & Co.	Iron Castings.
	33	Paul & McLachlan	Iron Castings.
	75	Burnet Packaging Ltd.	Iron Castings.
	76	Lane & Givan Ltd.	Iron Castings.



## Class III continued

	No.	Name	Type of Production
FALKIRK	93	Dunmure Iron Co. Ltd.	Iron Castings.
	174	Aitken's Brewery	Brewing and Making.
	192	Allied Iron Founders (Falkirk)	Iron Castings.
	215	Brick Works	Bricks, Fireclay.
	230	William Canning	Iron Castings.
	237	R. Taylor & Co.	Iron Castings.
	241	Jones and Campbell Ltd.	Iron Castings.

## Class IV minimum Protective Zone width 100 M.

BO'NESS	107	Calders & Grangridge	Timber.
	135	P. & W. McLean Ltd.	Metal Industries.
	141	J. & S. Dewar Ltd.	Boat Builders.
BONNYBIDGE AND DUNNY	3	John Collins Ltd.	Paper and Board.
	4	Cameron Brick Co.	Bricks, Fireclay.
	36	Bunkier Distillery	Brewing and Malting.
	39	J. G. Stein & Co. Ltd.	Bricks, Fireclay.
	66	Bonnybridge Silica & Fireclay Co.	Bricks, Fireclay.
	77	Anderson and Co.	Bricks, Fireclay.
	78	Railway Repair	Bricks, Fireclay.
	82	Brick Works	Bricks, Fireclay.
FALKIRK	90	W. Alexander & Co.	Motor Vehicle.
	91	Cairnus Iron Co. Ltd.	Iron Castings.
	92	Grange Camelon	Iron Castings.
	95	W. Alexander & Co.	Motor Vehicle.
	123	Scottish Gas Board	
	185	R. Melville and Co. Ltd.	Timber.
	191	A. L. Gordon Ltd.	Copper, Brass and Other.
	199	Allied Iron Founders (Larkhall)	Iron Castings.
	207	R. Melville and Co. Ltd.	Timber.
	213	J. K. Miller	Abrasives and Building Minerals
	225	Thomson (Caron) Ltd.	Motor Vehicle.
	242	Timber Yard	Timber.
	249	Timber Yard	Timber.
	254	Trunk Grangemouth Dep.	Storage and Loading of Concrete.
	258	Portland Cement	Storage and Loading.
GRANGEMOUTH	279	The Phoenix Timber Co.	Timber.
	284	S.C.W.S. Soapworks	Vegetable and Animal Oils.
	286	Watt Tannery	Timber.
	289	John Sinclair	Timber.
	293	I.C.L.	Pharmaceutical and Toilet.
	294	Mitchell & Sons	Timber.

## Class V minimum Protective Zone width 50 M.

BO'NESS	134	Saw Mill	Timber.
	138	Victoria Saw Mill	Timber.
	141	Smith Brothers	Wooden Containers and Barrels.
BONNYBIDGE AND DUNNY	60	Rollo Industries Ltd.	Metal Working Machine Tools.
FALKIRK	23	Starch Products Ltd.	Other Foods Products.
	172	R. Baird & Co.	Timber.
	176	R. Barr Ltd.	Other Drink Industries.
	184	Bisco	Prefabricated Concrete.
	214	Bisco	Prefabricated Concrete.
	233	McCowan & Sons Ltd.	Cocoa, Chocolate.
	240	C. Carpenter Ltd.	Metal Industry.
GRANGEMOUTH	267	B.C.M. Industrial Co.	Plastics Moulding.
	278	Timber Yard	Timber.
	295	Browne & Co.	Timber.
	297	McFarlane & McLaren	Timber.

## Appendix 5

### REHABILITATION AREAS

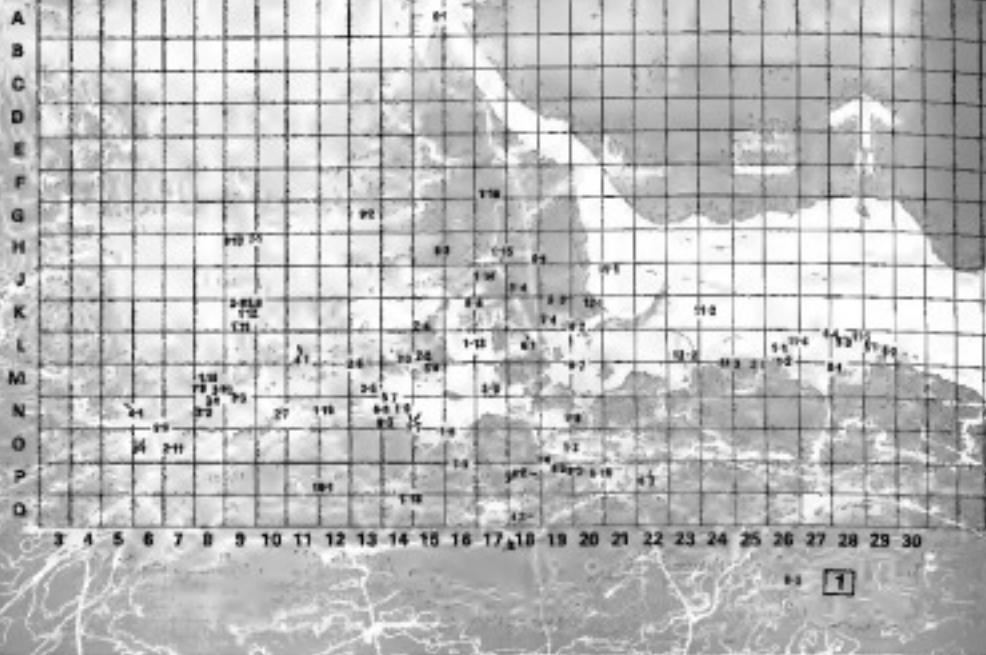
#### Type Numbers and Description

Type Number	Description	Criteria
1	Bings—Large mounds, usually of coal waste.	(a)
2	Tips—Plates where refuse, etc., is deposited.	(b)
3	Dredged sand and gravel quarries.	(c)
4	Dismantled railways.	(d)
5	Dredged sites, waste ground, etc.	(e)
6	Pearls, harbours, canals.	1
7	Dredged river quays.	2
8	Pit slacks and areas liable to subsidence.	3
9	Land liable to flood and badly drained areas.	4
10	Coraline poor quality soils.	5
11	The foreshore, mainly used flats between high and low water-mark.	6
12	Polluted rivers.	7
		8
		9
		10

#### Treatment

#### Site Identification (see Map No. 88: Rehabilitation—Site Identification)

Type and Identification Number	Map Reference Number	Location	Criteria	Description	Treatment
1 - 1	L.25	Bo'ness	a.	Conical mine waste, burning. To be used by Grangemouth Council for filling	1
1 - 2	L.25	Bo'ness	a.d.	Moundy, mine waste, grained and scrub. Rehabilitation scheme already approved	1.3
1 - 3	O.20	Redding	a.	Platform, steep sides mine waste. Being used slowly by adjacent factory	6.7
1 - 4	O.19	Redding Muirhead	a.d.	Moundy, extensive area mine waste, unburnt. Preliminary approval given for rehabilitation	1.3.5.6
1 - 5	P.16	Glen	a.b.	Moundy, mine and brick works waste, some burning	2.6
1 - 6	O.16	S. Falkirk	a.d.	Platform steep sides coal waste, grass and scrub to be removed and screened for coal	1.2.5.6
1 - 7	O.15	S.W. Falkirk	a.	Moundy, small bings of coal waste in woodland; to be removed and screened for coal	1.5.6
1 - 8	N.14	S.W. Falkirk	a.d.	Moundy, large mine waste, grass and scrub	1.3.5.6
1 - 9	M.8	Denny/Lochend	a.	Conical, mine waste, grained	1.5
1 - 10	M.8	Denny/Lochend	a.d.	Moundy, mine waste, grass and scrub	1.5
1 - 11	K.9	S. Denny	a.	Moundy, burn mine wastes, being removed	1.2.5
1 - 12	K.9	S. Denny	a.	Moundy, unburnt mine wastes	1.2.5
1 - 13	L.17	Falkirk	a.d.	Platform and ravines, partly grass covered. Is being screened for coal; and excavated	1
1 - 14	J.17	Carronshaws	a.	Moundy, caused by S.C.C., who will be removing it	1
1 - 15	H.17	Longdyke	a.	Conical, mine waste	1
1 - 16	P.17	S. Airth	a.	Ridge, mine waste, grained and scrub	1 or 2.5
1 - 17	H.9	N. Dunipace	a.	Moundy, burn mine waste	1.2.5
1 - 18	Q.15	S. Falkirk	a.	Moundy. This bing is not cut off by embankment	5
1 - 19	N.12	W. Falkirk	a.c.	Area of small bings, one large plateau bing. Scrub, grass and heather covered	2.3.5.6
2 - 1	L.25	Bo'ness	c.	Reservoir area, near road front	4.5.6
2 - 2	L.15	Falkirk	c.	Old sand quarry, badly drained	4.5.6



Map No. 88: Rehabilitation—Site Identification

Key: 1. Location and identification number of site to be rehabilitated.

*Site Identification continued*

Type and Identification Number	Map Reference Number	Location	Criteria	Description	Treatment
2-3	L.16	Falkirk	a.c.	Low lying area, crop for rubbish and spoil	4.5.3
2-4	K.15	W. Cenon	a.c.	Extensive area of iron works wastes	2.5
2-5	M.15	W. Falkirk	a.	Pitman, steep sides, scrub works waste	1.5.7
2-6	M.13	W. Falkirk	a.	Valley, being filled with spoil, etc.	4.5
2-7	N.10	Bonnybridge	a.	Area of small tips of works waste, fireclay, bricks, etc.	1.2 and 1.5
2-8	K.9	Denny	a.c.	Depression being filled with rubble, rubbish, etc.	4.5
2-9	K.10	Denny	a.	Sand quarry being reclaimed by refuse, etc.	4.2.5
2-10	N.9	Bonnybridge	a.c.	Sand quarry being reclaimed by coal screenings	4.2.5
2-11	O.7	Castlerey	a.	Fireclay works waste	6
3-1	N.8	W. Bonnybridge	a.c.	Sealing lagoon	4.5
3-2	N.8	W. Bonnybridge	a.c.	Moundy, exposed spoil, scrub	4.5
3-3	N.9	W. Bonnybridge	a.	Screening plant, etc., a necessary and useful process of a relatively temporary nature	1.2.5
4-1	N.5	Bonnybridge	a.c.	Bankamento of old railway, includes bridge abutments, etc.	1.2 3.8
4-2	F.18	Shrubhill	a.	Bankamento, etc., of old railway. May be utilized in reclamation system in future	9
5-1	L.29	Bo'ness	a.	Shapessaker's yard. This area should be moved or hidden or exposed to an interested public	8

## Site Identification continued

Type and Identification Number	Map Reference Number	Location	Crown's	Description	Treatment
5 - 2	L.28	Bo'ness	a.c.	Flat area of derelict terraces, rubbish, etc. on sea front	1.5.8
5 - 3	L.28	Bo'ness	a.c.	Flat area, midway slippings, etc. on sea front	1.5.8
5 - 4	K.19	Grangemouth	a.c.	Flat area, adjacent to River Carron. To be incorporated into Grangemouth open space system	5.6.8
5 - 5	M.17	Falkirk	a.c.	Unover, grass and scrub, rubbish etc. Approved rehabilitation area "Ladyhill"	3.4.5
5 - 6	M.15	Falkirk	a.c.	This site to be public open space "Merchiston"	1.2.4.5.6
5 - 7	N.14	Falkirk	a.c.	Sloping and flat area, scrub and rough grass. This site due for redevelopment	—
6 - 1	O.6	Region	a.b.c.	Forth and Clyde Canal from Grangemouth to Boness	8.9
6 - 2	K.20	Grangemouth	c.	Timber ponds, due to be filled in by Grangemouth Council	4
6 - 3	P.23	Region	a.b.v.	Union Canal, from Falkirk East to regional boundary	8.9
6 - 4	L.28	Bo'ness	a.b.c.	Bo'ness docks. An extensive area of harbour, now partly silted up. Adjacent to 5 - 3	8.9
7 - 1	H.10	N. Dunbar	c.	Thomondike Quarry. This area is being reclaimed by refuse disposal	4.5.8
8 - 1	M.28	Bo'ness	d.	Scattered pit shafts, shallow workings, etc.	see Mining Report
8 - 2	H.15	N. Carsephore	d.	Scattered pit shafts, shallow workings, etc.	see Mining Report
8 - 3	—	Region	d.	Other areas affected by shafts and possible subsidence include Gourock, Sandstone, Redding Muirhead, Fingask	see Mining Report
9 - 1	A.15	South Ayrshire	c.	Agricultural area, on upper reaches of Firth estuary	10
9 - 2	G.15	Letham	c.	Agricultural area on Pow Burn	10
9 - 3	H.19	N. Skirlaw	c.	Agricultural area, water rises from mines beneath. Spill from mine nearby	4.10
9 - 4	J.18	W. Skirfars	c.	Agricultural area, very flat and near sea level. Time between tides insufficient to allow natural drainage	10
9 - 5	K.19	R. Skirfars	c.	Agricultural area. Permanently high water table	4.5.10
9 - 6	K.17	Carlopside	c.	Agricultural area. Occasional flooding here from River Carron. Possible need for straightening	10
9 - 7	M.20	Grangemouth	a.	Urban area. Scheme in hand to divert Grange Burn	—
9 - 8	N.20	N. Westquarter	c.	Agricultural area. Flooding possibly due to pending behind bridge. Improved order for 9 - 7 will help	—
9 - 9	O.6	Boness	c.	Agricultural area. Bonnywater flooding and canal seepage	10
9 - 10	P.21	Ramford	a.	Urban area. Scheme in hand to straighten stream etc.	—
10 - 1	—	Region	c.	Agricultural area. Especially the Saltmarsh Plain	see Rehab. Report

## Site Identification continued

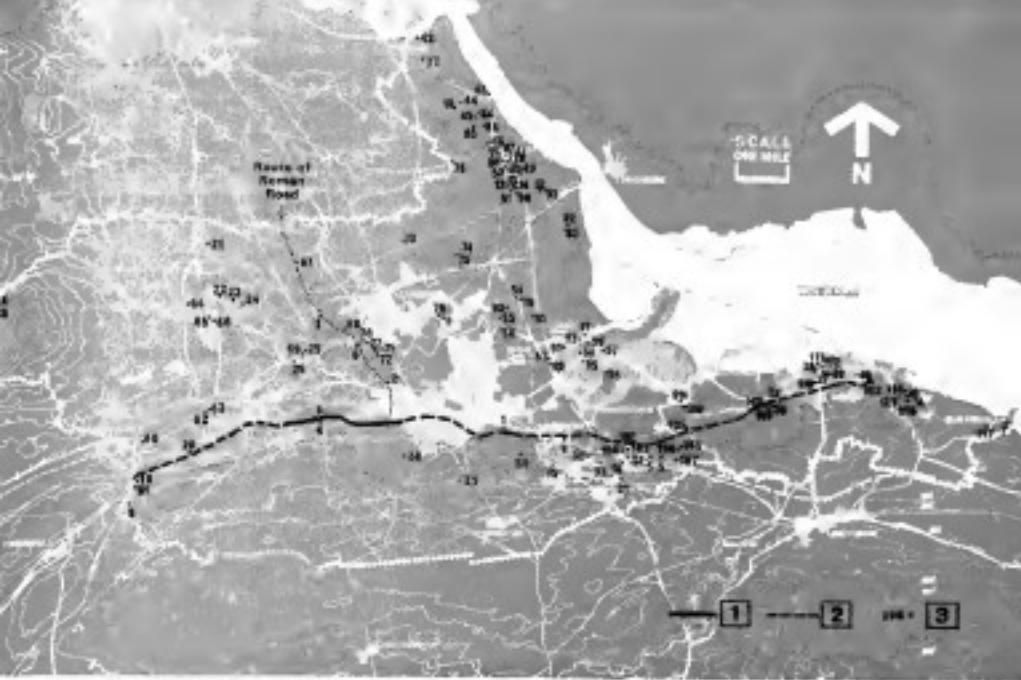
Type and Identification Number	Map Reference Number	Location	Criteria	Description	Treatment
11 - 1	J.21	W. Grangemouth	c.	Madflats, between high and low water mark, north of R. Carron. Approx. 1000 acres	4.5.6 9.10
11 - 2	K.24	E. Grangemouth	c.	Madflats, between R. Avon and Grangemouth Docks. Approx. 1200 acres	4.5.6 9.10
11 - 3	M.25	W. Kincard	c.	Madflats enclosed by old dyke at present being reclaimed by refuse tipping. Approx. 250 acres	4.5.6 9.10
11 - 4	L.27	E.N. Kincard	a.c.	Madflats, run right up to present cow-shed area	4.5.6 9.10
11 - 5	L.29	N. Bo'ness	a.c.	Madflats, extend along waterfront of proposed reclamation area. Approx. 75 acres	4.5.6 9.10
12 - 1	—	Region	a.b.c	River Carron, polluted by industrial and domestic wastes	see Rehab. Report
12 - 2	—	W. Bo'ness	a.c.	River Avon, polluted by industrial wastes	see Rehab. Report

## Appendix 6

ANALYSIS OF RANDOM SAMPLE OF MUNICIPAL COMPOST  
AFTER MATURING IN WINDROWS FOR THREE MONTHS

Trace elements *			ppm, as Dry Matter	
			Total	Available
Moisture content	—	—	50%	140 75
Organic matter	—	—	20%	40 1
Mineral matter	IN	—	30%	100 —
Nitrogen	DRY	—	0.7 - 1.0%	600 40
Phosphorus	MATTER	—	0.3 - 0.6%	30 2.5
Potassium	—	—	0.3 - 0.6%	500 70
Iron	7.3	—	—	30 10
				140

\* The figures given for trace elements are obviously dependent on the analysis of the new edition, and relatively large variations may be expected from different samples.



Map No. 89: Historic and Architectural Interests

Key: 1. Visible remains of Roman Wall. 2. Line of Roman Wall. 3. Structure or site of interest.

## Appendix 7

### HISTORIC AND ARCHITECTURAL INTERESTS

The following lists give the map reference number and show the extent of structures and sites of Historic and Architectural Interests in the Grangemouth/Falkirk Growth Area (see Map No. 90, "Historic and Architectural Interests"). Except for the Roman remains, these were compiled from the Scottish Development Department's "List of Buildings of Historic and Architectural Interest". The items are officially graded into 3 categories denoting their significance for preservation purposes, "A" being the best. In some cases while individual buildings have no intrinsic merit nevertheless as part of a building group or street they make a particular contribution to the urban scene.

#### Roman Remains

1. Antonine Wall
2. Supposed site of City at Camelon
3. Line of road
4. Posts
5. Sites of camps
6. Site of bridge

#### Category 'A'

7. Blackness Castle, 15 century
8. Castle Cary, 15 century
9. Stenhouse Castle, 1622
10. Garden Wall and Pineapple, Dunmore Park, 1761
11. The Old Smithy, Airth
12. Mercat Cross, Airth, 1697 (Scheduled Monument)

13. Airth Church near castle, 16 century
14. Airth Castle, 16-17 century
15. Devonian Westquarter 1647 (Guardianship Monument)
16. Parkhill House, 1789
30. Mausoleum, Calderwood Park, early 19 century

#### Category 'B'

17. Nos. 4-14, South Basin Street, Grangemouth, 18 and 19 century
18. Old Bridge, Fyviekin Burn, Dumbynair
19. Red Brae Viaduct, near Castlecary, 1842
20. Underwood lock, near Bonnybridge
21. Quarter House, near Dales Wood, 18 century
22. Parish Church, Dunipace Parish, 1834
23. Denman Mains, Dunipace, 17-18 century
25. Devonian, Dunipace Park
26. Dunipace Bridge, 18 century
27. Old Manse, Bothkennar, 18 century
28. Obelisk, Greenbank, erected 1927
29. Glen Bridge, Glen Village, 1822
31. Polmont House, 17 century
32. West Lodge and gatepiers, Parkhill, late 18 century
33. Dovecot, Parkhill, 1814
34. Polmont Church, 1731
35. Cottages, Kinnell, 17-18 century
36. Kinneil House, 1675 (Guardianship Monument)
37. Nos. 15-15 South Street and Gibson's Wynd, Bo'ness, 18 century
38. Warehouses, Scotland's Close and Wagon Road, Bo'ness, 1772

39. Tennessee North Street, Bo'ness, 1786  
 40. Cowdenhill House, Bridgemoss, Bo'ness, 1676  
 41. Carriden House, 1692  
 42. Kenrie Mains, near South Alloa, 17 century  
 43. Dunmore Village, mid. 19 century estate development  
 44. Dunmore Park 1820-22  
 45. The Passage, Dunmore, early 19 century  
 46. Town, Dunmore Park, 15-16 century  
 47. Captain's House, Airth  
 48. Leggat's House, and house in Shoe Road, Airth, 18 century  
 49. Airth Parish Church, 1820  
 50. Vire Villa, Airth, 1722  
 51. Sandie and Goway, Airth Castle, 18-19 century  
 52. The Neck Mansion, near Airth, 1810-20  
 53. Stables and Dovecote, the Neck  
 54. Bothkennar Mains, near Carnsaheek, 1816  
 55. Carron House, late 18 century  
 56. Dovecote, Carron House, 18 century  
 57. Round House, Dalgreen Bridge Grangemouth, 18 century  
 58. Bothkennar Church 1789
- Category 'C'**
59. New Carron Bridge, Dennybank, 19 century  
 60. Hagg Church, 1840  
 61. Red Barn Bridge, near Castle Cary, early 19 century  
 62. Crown Hotel, Dennyloanhead  
 63. Church and old graveyard, Dennyloanhead, 1745  
 64. Stables of Heriotshire Castle, Denny, early 19 century  
 65. Rosepark Church, Denny, 1797 and 1881  
 66. Denny Parish Church, rebuilt 1813  
 67. Larbert House, 1820  
 68. Church site and old graveyard, Dunipace Park  
 69. Church site and old graveyard, Dunipace Park  
 70. Larbert Parish Church, 1814-1820  
 71. Old Larbert Bridge, early 19 century  
 72. Larbert Viaduct, early 19 century  
 73. Kersbrough Farmhouse, Hill of Kinnaird, 18 century  
 74. Walled garden, Kinnaird House, 1802 and early 19 century  
 75. Stable group, Kinnaird House, 1825  
 76. Stables, Stenhouse Castle, 18-19 century  
 77. South Kerse, near South Alloa, 18-19 century  
 78. Club's Tench, near Airth, 18 century  
 79. Westerton Farmhouse, near Carnsaheek, late 18 century
81. Lodge Cottage, Skinflats, late 18 century  
 82. Powlowton, early 19 century  
 83. Stables and dovecote, Powlowton, early 18 century  
 84. St. Andrew's Church, Dunmore Park, 1850  
 85. Stables and Dovecote, Dunmore Park, early 19 century  
 86. Lodge, Dunmore Park, early 19 century  
 87. Rotheray Villa and Manor House, Airth, early 19 century  
 88. School House (Rosebank) and Path Cottage (Bankside) Airth, 18-19 century  
 89. Elphinstone Inn and adjoining dwellings, Airth  
 90. Stables, early 19 century and old cross, Airth Castle  
 91. West Church, Dalgreen Road, Grangemouth, 1837  
 92. Kerse Lodge and garden wall, Grangemouth, early 19 century  
 93. Ship's chandlery, Grangemouth, early 19 century  
 94. Old Zealand Arms, North Basin Street, Grangemouth, early 19 century  
 95. The Ship Inn, North Basin Street, Grangemouth, early 19 century  
 96. Grangemouth Basin, 1800  
 97. Old Harbour, Grangemouth, 1800  
 98. Buildings in North Harbour Street, Grangemouth, early 19 century  
 99. Avon Bridge Cottage, early 19 century  
 100. Avon Bridge, early 19 century  
 101. Inveravon Tower, 15 century  
 102. School House, Polmont, 1789  
 103. Lodge and Park, Polmont House, early 19 century  
 104. Mains, Polmont, 1735  
 105. Avondale House, early 19 century  
 106. Stables, Avondale House, early 19 century  
 107. Gazebo, Avondale Park, early 19 century  
 108. Old Kinnell Kirk, medieval  
 109. James Watt's Cottage, 18 century, and boles at Kinnell House  
 110. 68 South Street, Bo'ness, 18 century  
 111. West Pier Tavern, Scotland's Close, Bo'ness, 18 century  
 112. Douglas Hotel, East Pier Street and North Street, Bo'ness, 18 century  
 113. Dovecote, near New Grange House, Kinnaird Park, Bridgemoss, 17 century  
 114. Carriden Church, 1609  
 115. Old Carriden Church, 1766 and 19 century  
 117. Blackness House, early 19 century

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